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Analysis of knowledge by Brazilian speech therapists about the battery Evaluation of Auditory Responses to Speech

Análise do conhecimento de fonoaudiólogos brasileiros sobre a bateria Evaluation of Auditory Responses to Speech

Análisis del conocimiento de logopedas brasileños sobre la batería de Evaluation of Auditory Responses to Speech

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Abstract

Introduction: The advancement of hearing technologies has helped hearing-impaired children to hear, but it is necessary to monitor the development of hearing and oral language skills. **Objective:** The objective of this article is to analyze the knowledge of Brazilian speech therapists about the EARS battery, which presents nine protocols for evaluating the development of auditory and oral language skills. **Method:** This is a quantitative and qualitative, cross-sectional, descriptive study. Data collection was carried out using the Google Forms in a digital environment. The questionnaire consisted of 13 questions, four about the professional's profile and nine about their knowledge and/or use of protocols proposed by the EARS battery. 67 participants responded to this study. **Results:** Of this total, 70% work directly in speech therapy, 41% work in both private and public services. 97% consider it important to use protocols for evaluating and monitoring auditory and oral language skills and 92% feel that validated protocols are lacking. Regarding the use of EARS battery protocols, it was found that the most common are MUSS, MAIS, GASP and MTP. **Conclusion:** The tests that Brazilian speech therapists most adopt

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are the MUSS, MAIS, GASP and MPT. Most use more than one protocol in assessment, monitoring and even rehabilitation. However, it is noted that there is still a lack of validated protocols to cover the stages of development of auditory and oral language skills in children with hearing impairment.

Keywords: Hearing loss; Cochlear implants; Hearing aids; Protocols

Resumo

Introdução: O avanço das tecnologias auditivas tem ajudado crianças com deficiência auditiva a ouvir, mas é necessário acompanhar o desenvolvimento das habilidades auditivas e de linguagem oral. **Objetivo:** O objetivo deste artigo é analisar o conhecimento de fonoaudiólogos brasileiros sobre a bateria EARS, que apresenta nove protocolos de avaliação do desenvolvimento das habilidades auditivas e de linguagem oral. **Método**: Trata-se de um estudo quantitativo e qualitativo, transversal descritivo. A coleta de dados foi realizada por meio do formulário Google *Forms* em ambiente digital. O questionário foi composto por 13 questões, sendo quatro sobre o perfil do profissional e nove sobre seu conhecimento e/ou uso de protocolos dos propostos pela bateria EARS. Responderam a este estudo 67 participantes. **Resultados:** Desse total, 70% atuam diretamente na terapia fonoaudiológica ,41% atendem tanto em serviço privado como público. 97% consideram importante o uso de protocolos de avaliação e monitoramento das habilidades auditivas e de linguagem oral e 92% sentem falta de protocolos validados. Com relação ao uso dos protocolos da bateria EARS, constatou-se que os mais comuns são o MUSS, o MAIS, o GASP e o MTP. **Conclusão:** Os testes que os fonoaudiólogos brasileiros mais adotam são o MUSS, o MAIS, o GASP e o MPT. A maioria usa mais de um protocolo na avaliação, no monitoramento e mesmo na reabilitação. No entanto, nota-se que ainda há carência de protocolos validados para contemplar as etapas de desenvolvimento das habilidades auditivas e de linguagem oral de crianças com deficiência auditiva.

Palavras-chave: Perda auditiva; Implantes cocleares; Auxiliares de audição; Protocolos

Resumen

Introducción: Los avances tecnológicos relacionados con las tecnologías auditivas han ayudado a los niños con pérdida auditiva a oier mejor, sin embargo es necesario monitorear el desarrollo de las habilidades auditivas y del lenguaje oral. **Objetivo**: Este artículo trata de un análisis del conocimiento de los fonoaudiólogos brasileños sobre la Batería EARS, que presenta nueve protocolos para evaluar el desarrollo de las habilidades auditivas y la percepción del habla en niños con pérdida auditiva que utilizan dispositivos de amplificación de sonido e implantes cocleares. **Método:** Se trata de un estudio transversal descriptivo cuantitativo y cualitativo. La recojida de datos se realizó mediante el formulario Google Forms en un entorno digital. El cuestionario constaba de 13 preguntas, siendo cuatro de libre elección y relacionadas con el perfil del profesional y nueve relacionadas con el uso de protocolos y el conocimiento y/o el uso de protocolos propuestos por la Batería EARS. En este estudio participaron 67 encuestados. **Resultados:** De este total el 70% actuan directamente en terapia fonoaudiologica y el 41 % atienden tanto en el servicio público como privado. El 97% consideran importante el uso de protocolos de evaluación y seguimiento de las habilidades auditivas y del lenguage oral y el 92% afirman que faltan protocolos válidos. Con relación al uso de los protocolos de bateria EARS, se llegó a la conclusión que los más usuales son el MUSS, el MAIS, el GASP y el MTP. **Conclusión:** Las pruebas más utilizadas por los fonoaudiólogos brasileños son MUSS, MAIS y GASP y MTP. La gran mayoria utiliza mas de un protocolo en la evaluación y seguimiento y en la rabilitación, sin embargo se nota que faltan protocolos .

Palabras clave: Pérdida de audición; Implantes cocleares; Audífonos; Protocolos

Introduction

Scientific advances provide evidence that full functioning of the peripheral and central components of the auditory system compete for the development of speech and language, and that the first six years of life of the child is the critical time window of neuroplasticity. This period entails stages of development which hinge on neural activation together with a host of molecular mechanisms, plus stimulation, attention and motivation[1,2].

In cases of diagnosed hearing loss, a solid language base is built through ample exposure to speech and language, in addition to adequate adaptation to hearing technology, such as hearing aid devices or cochlear implants. Child-adult interactions should involve affection and conversational exposure. The family plays a pivotal role throughout the process of auditory rehabilitation.

Broader and more timely diagnosis of hearing loss is necessary, hence the importance of neonatal auditory screening, enshrined in law[3].

Irrespective of the degree of hearing loss, access to speech sounds may be partially or totally impaired. In order to achieve oral language production, hearing aids or cochlear implants should be fitted and validations performed to ensure auditory access. Hearing aids alone, devices incorporating digital components to enhance sound signal quality, are not enough to ensure proper development of hearing and oral language abilities. Speech-hearing-language intervention is fundamental from the outset of the process. To this end, effective assessments are needed throughout the rehabilitation process, the results of which help guide the development of abilities and skills[1,4-7].

In Brazil, there is a dearth of validated instruments for assessing and monitoring auditory rehabilitation readily accessible to hearing healthcare professionals[8].

The translation and adaptation of these tests is commonly undertaken worldwide. This is the case for the EARS (Evaluation of Auditory Responses to Speech) battery[9], devised in 1995 by Allum-Mecklenburg together with audiologists, speech therapists, ENT physicians, linguists and psychologists. The team adapted, combined and systematized a number of different tools for evaluating auditory responses in collaboration with the company MED-EL. The protocol has been translated and adapted to over 20 languages, including European Portuguese[10].

The objectives of the instrument are to evaluate the development of auditory abilities and speech perception of children with hearing loss in use of hearing aids or cochlear implants, provide support for the processes of adaptation and rehabilitation of these individuals, and to serve as a battery of short, medium and long-term assessment tests [9].

Based on the results of the speech perception test battery, the development of speech and language skills of hearing-impaired users of hearing aids can be improved, cochlear implants mapped and hearing aid devices programmed.

The EARS battery comprises 9 protocols each of which is applicable to a specific age group:

- LiP – Listening Progress Profile

Aged 1 year and older. Measures the auditory perception of a range of sounds, including speech, and the development of auditory discrimination. This protocol also assesses spontaneous or structured behavior for environmental sounds, musical instruments and voices.

- MTP – Monosyllabic-Trochee-Polysyllabic

Aged 2 years and older. Tests the child´s ability to identify different syllable patterns: 1, 2, or >2 syllables.

- Monosyllable closed-set test

Aged 3 years and older. Assesses the ability to identify familiar monosyllabic words.

- COT – Common Objects Token Test

Aged 3 years and older. Assesses the ability to understand phrases through following verbal instructions.

- Closed-set sentence test

Aged 4 years or older. Tests the ability to identify familiar coarticulated words.

- Monosyllable open-set test

Aged 4 years or older. Assesses the ability to recognize monosyllabic words.

- GASP – Glendonald Auditory Screening Procedure

Aged 5 years and older. The GASP comprises 6 tests; for the EARS protocol, only test 6 was applied, used to assess the ability to recognize simple questions.

- MAIS – Meaningful Auditory Integration Scale

Using a questionnaire containing 10 indirect questions, the test assesses the spontaneous reactions of the child to sounds associated with their everyday routine. There are two versions: the IT-

MAIS, applied to children aged up to 4 years; and the MAIS, applied to children aged 4 years or older.

- MUSS – Meaningful Use of Speech Scale

All ages. Assesses the use of speech by the children in their everyday routine.

Currently, hearing aid devices and cochlear implants are considered advanced technologies and provide auditory access, but do not guarantee the child will start to speak. In these cases, auditory rehabilitation is important, together with the protocols for assessing and monitoring hearing and language. These tools follow the developmental milestones and have standards which can help guide any changes in the interventions and monitor progress of hearing and language abilities of the child.

In 2000, Allum et al.[11] investigated changes in auditory perception and speech identification in 71 children with cochlear implants. The test material was a reduced form of the EARS evaluation protocol test with the LIP, MTP and MAIS components. The authors reported that these protocols proved valuable for showing performance improvements of cochlear implant children in all age groups.

In 2003, Sainz et al.[12] assessed auditory skills in 140 cochlear implant children by applying the LiP and MPT components of the EARS protocol. The results showed that auditory skills improved within 2 years of implantation in the children assessed.

In 2012, using the full complement of tests from the EARS battery, Esser-Leyding and Anderson[13] conducted a multi-center study of 765 cochlear implant children and assessed the development of auditory skills during the first 5 years after cochlear implantation. The authors found that auditory perception skills improved significantly over the 5-year follow-up.

For 3 years after cochlear implantation in children aged 1-7 years, Popov et al.[14] applied the protocols of the EARS battery to 30 patients. The study results suggested a statistically significant difference among the tests. The LIP and MTP exhibited significance, but the GASP was not as sensitive for measuring performance of the patients.

Al Sanosi and Hassan[15] evaluated 67 children pre-operatively and at 3, 6, 12, 24 months of cochlear implant device experience. The authors also applied the LiP, MTP and MAIS protocols, besides the Standardized Arabic Language test, to assess auditory skills, speech perception and language production. The study concluded that the hearing outcomes of children with severe and profound pre-lingual deafness implanted under 5 years of age were better than late-cochlear implanted children.

Nandurkar and Susmitha[16] assessed 12 children aged 1-5 years, applying the LIP protocol one week before surgery and during the first 3 months after implantation. The authors reported that the development of auditory skills was triggered as soon as cochlear implantation was performed and concluded that LIP was a major tool for classifying progress of the children. Likewise, in a 2000 study, Nikolopoulos et al.[17] considered the LIP protocol a sensitive tool for measuring progress in auditory skills in cochlear-implanted children.

Ngui et al.[18] performed a literature review and clinical experience in bilateral simultaneous cochlear-implanted children and adults. All pediatric patients showed improvement on the MAIS, MUSS, LIP protocols, and on the Parents' Evaluation of Aural/Oral Performance of Children and Ease of Listening (PEACH), with rate of improvement varying according to factors such as age at implantation and the child´s behavior.

Silva et al.[19] applied tests 5 and 6 of the GASP in 180 children to verify whether age at cochlear implantation, in 3 age groups ranging from 18 to 30 months, influenced the development of auditory recognition abilities. Based on the application of these tests at 60 months of cochlear implant use, the results showed that children had attained more complex hearing abilities.

Rawes et al.[20] evaluated 12-month outcomes of 49 children with multiple additional needs receiving cochlear implantation over a 10-year period. The hearing performance protocols MAIS, MUSS, LIP, Categories of Auditory Performance (CAP), and Speech Intelligibility Rating Scale (SIR) were employed. Based on outcomes, the authors found that all children were able to gain access to sound following cochlear implantation. Improvements were seen on all outcome measures, especially the MAIS, CAP and LIP, whereas limited improvements were observed for measures assessing speech production and improvement.

Ferreira[21] studied the relationship between parenting styles and auditory skills in children using cochlear implants. Two study groups were formed: a group of cochlear implant users and a group containing children without hearing complaints. The author applied the MAIS protocol to analyze auditory performance and found that higher

scores for auditory skills in the implanted group were significantly associated with democratic parenting styles.

A number of authors of different languages have responded to the need to adapt the EARS battery in a bid to improve follow-up of auditory, oral and language skills of children with hearing loss in use of hearing aids. Amid a context where technological advance and commitment with the development of these skills are adopted as part of routine clinical practice, the aim of the present study was to determine whether Brazilian speech therapists working in this area use and/or hold knowledge on some or all of the tests in the EARS battery.

Method

The study was approved by the Research Ethics Committee of Irmandade da Santa Casa de Misericórdia de São Paulo, under permit no. 26420619.3.0000.5479. A descriptive, cross-sectional study with a quantitative and qualitative approach was conducted. The data were collected using Google Forms in a digital environment. The form was sent to 107 speech-hearing professionals who worked in hearing healthcare at both public and private healthcare providers throughout Brazil. For recruitment, individuals were invited to take part by electronic mail (e-mail) between May and December 2021, with invitations sent out on 3 occasions during this period. A total of 67 respondents took part in the study.

Inclusion criteria were practitioners engaged in the area of auditory rehabilitation from any part of Brazil. Prior to completing the questionnaire, all participants were asked to sign the online Free and Informed Consent Form, with questions released only after acceptance. The questionnaire comprised 13 questions divided into 2 sections. None of the questions were compulsory, where participants were free to answer them separately and choose more than one answer option.

The first section contained 4 open choice questions on the profile of the professional: area of practice in auditory rehabilitation (speech-hearing therapy, hearing aid selection, or assessment of candidates for cochlear implantation and mapping); time practicing in the area; age group; and place of practice (whether public or private service, or both).

The 9 questions of the second section were open choice and probed the use of protocols, frequency of application, knowledge and/or use of the protocols contained in the EARS battery, along with one descriptive question about any other protocol used by the participant in their evaluations not listed in the questionnaire.

The survey results were placed in figures of a Microsoft Excel spreadsheet and data were subsequently analyzed.

Results

A total of 67 speech therapists were assessed (age 23-64 years), 70% practiced speech-language therapy directly, 41% engaged in hearing aid selection and adaptation, and 38% performed candidate assessment and/or cochlear implant mapping. Respondents could select several different areas of auditory rehabilitation in which they were involved. Regarding time period practicing in the area, most professionals reported >20 years (36%), followed by 13-20 years (21%), 9-12 years (22%), 4-8 years (10%), and <3 years (11%) (Table 1).

Table 1. Sample characteristics of role in auditory rehabilitation, time practicing in area, and place of practice

Characteristics	Responses N (%)
Role in auditory rehabilitation	*
Speech-hearing therapy	46 (70%)
Hearing aid selection and adaptation	27 (41%)
Candidate evaluation and cochlear implant mapping	25 (38%)
Time practicing in area	
0-3 years	8 (11%)
4-8 years	7 (10%)
9-12 years	15 (22%)
13-20 years	14 (21%)
>20 years	24 (36%)
Place of practice	
Private service	22 (33%)
Public service	16 (24%)
Both	29 (43%)

Note: (*) more than one response possible

Overall, 85% of respondents treated both pediatric and adult patients, whereas only 15% saw adults only.

Regarding place of work, 33% of professionals worked for private health service providers, 24% public service, while 43% worked in both public and private settings (Table 1).

For use of protocols to assess or monitor hearing aid or cochlear implant users, 92% reported using these tools, employing both formal and informal protocols. Overall, 93% of respondents deemed it important to use protocols for assessing hearing and language abilities of children with hearing loss and 92% felt there was a lack of validated protocols available (Table 2).

Table 2. Participant responses for section 2

Section 2	Responses N (%)
Do you apply protocols when assessing/monitoring patients with hearing aid or cochlear implant? *	
Yes	60 (92%)
No	5 (8%)
Indicate which skills are part of your evaluation protocol:**	
Hearing	58 (89.2%)
Oral language production	58 (89.2%)
Hearing language comprehension	58 (89.2%)
Speech	52 (80%)
Cognition	39 (60%)
Literacy	21 (32.3%)
Pragmatic	28 (43.1%)
Do not use	4 (6.2%)
Indicate which protocols you use*:	
Formal protocols	9 (13.8%)
Informal protocols	8 (12.3%)
Both	45 (69.2%)
Do not use	3 (4.6%)
How often do you apply protocols**	
Every 3 months	19 (23%)
Every 6 months	42 (51%)
Once a year	17 (21%)
Do not apply	4 (5%)
Do you feel there is lack of validated protocols*	
Yes	60 (92%)
No	5 (8%)
Do you deem the use of assessment protocols for monitoring the hearing and language of children with hearing loss important*	
Yes	63 (97%)
No	2 (3%)
When do you use assessment protocols**	
At initial evaluation	57 (87.7%)
For monitoring follow-up visits	36 (55.4)
For cochlear implant mapping/hearing aid adjustment	23 (35.4%)
In speech-hearing therapy	38 (58.5%)
When observing need/difficulty	37 (56.9%)
Do not apply	4 (6.2%)

Note: (*) No answers available for 2 respondents; (**) Respondents may choose more than 1 alternative

The survey results revealed that 89% of the speech therapists evaluated language hearing comprehension and oral production and auditory performance, particularly during the start of the assessment process, and frequency of reevaluation or monitoring was typically weekly (Table 2).

With respect to use of the protocols from the EARS battery, the MUSS, MAIS, GASP and MTP tests were the most commonly used (Table 3). It was noted that many professionals do not apply the other protocols because they do not have knowledge about them.

Table 3. EARS protocols: profile of knowledge and use

Protocol	Use N	Don't use N	Knowledge but don´t use N	No knowledge N
LiP	9	17	16	25
MTP	54	2	5	6
Monosyllable closed-set test	32	8	8	19
COT	9	16	16	26
Closed-set sentence test	39	6	6	16
Monosyllable open-set test	32	8	8	19
GASP	47	2	12	6
MAIS	47	4	8	8
MUSS	47	4	8	8

In response to the open question on other protocols used, besides the EARS battery, the most used instruments were the PEACH, LittlEars, the speech perception test, list of sentences, speech perception tests with drawings, the ABFW and the ADL.

Discussion

The study was conducted during the coronavirus pandemic, whereby lockdown may have been one of the reasons for some professionals failing to answer the questionnaire, despite this being sent electronically.

This brief overview of the profile of speech-language professionals reveals that time practicing was not a factor influencing knowledge and application of the most used protocols from the EARS battery, particularly the MUSS and MAIS, in as far as both these tests were translated and validated for Brazilian Portuguese over 20 years ago. However, this fact highlights the need for new protocols which embrace emerging specificities of new auditory rehabilitation technologies, especially in the pediatric area.

The EARS battery has been extensively studyed over the past 28 years. Many authors [13,14,16-19] from different corners of the globe have assessed hearing and oral language skills in the pediatric population with hearing loss to track progress in the development of these abilities, in conjunction with the use of the latest technology.

It is important to associate hearing ability and speech perception and assess the performance of these skills, since pooling information for the speech signal is a requisite for the development of oral language of children who use hearing aids. The protocols of the EARS battery compile speech perception information, including detection, discrimination, identification, recognition and comprehension (words/sentences) in silent or noisy environments. Application of these tests requires auditory access and, thus, low scores on the protocols serve as an alert for professionals to reassess the efficacy of hearing aids, as well as the rehabilitation program in which the child and their family are engaged.

The study by Ngui et al.[18] also corroborates that a group of protocols compete to gauge the efficacy of rehabilitation methods and strategies applied. Hearing healthcare professionals and family members should follow, monitor and analyze the outcomes of these protocols in order to support their decisions, constituting an indispensable part of the auditory rehabilitation process.

Studies involving the EARS vary according to age group and the need to evaluate different skills; all 9 protocols may be applied or any combination of 2 or more. The advantages of this approach are an analysis using different tools for each stage of development and short, medium and long-term follow-up periods.

The study by Nikolopoulos et al.[17] confirms the advantages of follow-up as an evaluative and predictive measure. Regular assessments are also important for the patient´s family: monitoring of the developmental milestones can reveal promising responses, validating the work and efforts of parents.

In a family-centered model[23], these resources can be positive allies for the whole team – parents, child, therapists and school. This is underpinned by the notion that language is constructed from conversational exposure and the consistent use of hearing aids.

The data presented in Table 2 shows that the frequency of reassessments by Brazilian professionals is, on average, every 6 months. Hearing and oral language skills are monitored by both the speech therapist and the speech-hearing-language professional who maps the cochlear implant, and also during the process of checking and validating hearing aid devices. In the present study, 56% of professionals reported applying protocols upon noticing any signs of hearing loss.

In some cases, the professional may concentrate on only one skill – auditory or language – and may overlook potential risks of delays in other areas. A joint assessment of several abilities can serve as a predictor.

The MAIS and MUSS questionnaires appeared to be well accepted by the speech therapists interviewed. These questionnaires contain fewer and more straightforward questions assessing reactions and speech perceptions in everyday situations of the child, with the added advantage of having been translated into Brazilian Portuguese in 1997[24]. More recently, Estima et al.[25] applied the IT MAIS, MAIS, MUSS and GASP protocols in 15 cochlear-implanted children and concluded that these protocols are markers of the association between hearing and some categories of speech, showing that the development of oral language depends on the development of hearing. The same study found that family participation favors the development of hearing and oral language skills.

In Brazil, Bevilacqua and Tech[26] devised a protocol for assessing the speech perception of children with hearing loss using subitems of different international tests. These tests included the list of sentences from the GASP, with 4 sentences that differed to the original published by Erber [27]. As evidenced by the present study results, this is one of the most used protocols for assessing the ability to recognize simple questions.

In the current investigation, 9 speech-hearing professionals reported using the LIP which, as reported by other authors[18,28], is an important test for measuring performance of speech perception in longitudinal follow-ups of cochlear implanted children. However, more in-depth studies in Brazil are warranted, beginning with the validation of the tool in Portuguese. Although the translation of the EARS battery adapted to European Portuguese is available, at the time of writing, no studies validating the tool were found.

The GASP protocol which, as outlined earlier, underwent some adaptations, has proven an effective instrument. The COT, on the other hand, warrants attention as, although seldom used in Brazil, this instrument has a Portuguese version available yet respondents cited they did not use or hold knowledge on this tool. However, given the COT provides a measure of the ability to understand phrases through following verbal instructions, the tool can make a significant contribution in the battery of assessments.

Recognition of words – monosyllables, dissyllables or trisyllables or phrases in open set or closed set situations – were assessed by the professionals using standardized tests or protocols such as applying the Minimum Hearing Capacity Assessment Test (TACAM)[29] and the naming test using the ABFW[30]. The monitoring of phonological acquisition is also an indispensable resource for assessing milestones of phonological development and recognition in silent and noisy environments. In the process of validation of hearing aids in everyday situations, the PEACH and LittlEars protocols, validated for use in Brazil, were also applied by the survey respondents.

All of the protocols contained in the EARS battery are designed, within its hierarchical scale of chronological age versus auditory age, to measure the development of hearing and oral language skills in pediatric users of hearing aids with hearing loss. Upon gaining access to the world of sounds, these

children require greater assistance from speech-hearing therapists and family members.

When probed whether they perceived a lack of validated protocols, 92.3% of the professionals stated yes, and deemed assessment protocols for monitoring the hearing and oral language of these children an important resource.

The data presented in Table 3 serve as an alert to hearing health-care professionals. There is still a dearth of validated protocols for measuring language skills in children with hearing loss, although protocols validated over 20 years ago cited in this are predictive for signs of hearing problems in cases where skills fail to develop as expected.

Conclusion

The tests most adopted by the Brazilian speech-hearing therapists surveyed were the MUSS, MAIS, GASP and the MPT. The majority of the professionals used more than one protocol for assessment, monitoring and during rehabilitation. There is a need for further validated protocols and studies to help inform hearing healthcare professionals and provide robust reliable data, where assessing the effects of auditory stimulation on the development of listening and oral language skills in young children with hearing loss remains a challenge.

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