https://doi.org/10.23925/2176-2724.2021v33i2p330-338

Speech-language pathology findings in adolescent with type I diabetes mellitus: a case report

Achados clínicos fonoaudiológicos em adolescente com diabetes *melittus* tipo I: relato de caso

Hallazgos de patología del habla y lenguaje en un adolescente con diabetes mellitus tipo I: reporte de un caso

*Jesus Claudio Gabana-Silveira**
Cíntia Filippi,***
*Carolina Lisbôa Mezzomo***

Abstract

Introduction: Type 1 diabetes mellitus (DM1) is characterized by the destruction of beta cells of pancreatic islets, manifesting in symptomatic hyperglycemia, due to an absolute insulin deficit, generating vital dependence on exogenous insulin. It is considered typical in children and adolescents; however, it can develop at any age. There are countless findings of auditory alterations in people with DM1, but there are no studies in other areas of Speech-Language Pathology. **Objective:** to report the case of an adolescent with a recent diagnosis of type I diabetes mellitus and Speech-Language Pathology disorders in the speech area - phonetic deviation in the phoneme /r/ - and auditory processing. **Case report:** An 11-year-old teenager arrives at the Speech-Language Pathology department for not being able to perform the /r/. Right after speech assessment and treatment initiation, he underwent an auditory processing exam, which showed changes. After 30 sessions of speech therapy, auditory processing was successfully treated. **Discussion:** The findings of the case corroborate with those described in the consulted literature.

* Prefeitura Municipal de Nova Bassano, Rio Grande do Sul, Nova Bassano-RS, Brazil.
** Universidade Federal de Santa Maria, Santa Maria, RS, Brazil.

Authors'contributions:
JCGS: Study conception; Methodology; Data collection; Paper draft; Critical review; Guidance.
CF: Study conception; Methodology; Data collection; Paper draft.
CLM: Methodology; Critical review; Guidance.

Correspondence email address: Jesus Claudio Gabana-Silveira - cgabana@gmail.com
Received: 05/08/2020
Accepted: 05/03/2021

Conclusion: The present study is relevant due to the scarcity of studies with more participants, with other areas of Brazilian Speech-Language Pathology, other than only Audiology.

Keywords: Speech, Language and Hearing Sciences; Type 1 diabetes mellitus; Adolescent

Resumo

Introdução: O diabetes *mellitus* tipo 1 (DM1) se caracteriza pela destruição das células beta das ilhotas pancreáticas, manifestando-se em hiperglicemia sintomática, devido a um déficit absoluto de insulina, gerando dependência vital de insulina exógena. É considerado típico em crianças e adolescentes; entretanto, pode se desenvolver em qualquer idade. Há inúmeros achados de alterações auditivas em pessoas com DM1, porém não há estudos em outras áreas da Fonoaudiologia. **Objetivo:** relatar o caso de um adolescente com diagnóstico recente de diabetes *mellitus* tipo I e alterações fonoaudiológicas na área da fala – desvio fonético no fonema /r/ - e de processamento auditivo. **Apresentação do caso:** Adolescente de 11 anos de idade vem encaminhado para Fonoaudiologia por não conseguir executar o /r/, com histórico de atendimento fonoaudiológico prévio. Logo após avaliação de fala e início do tratamento, realizou exame de processamento auditivo, que apontou alteração. Após 30 sessões de fonoterapia, o processamento auditivo foi tratado com sucesso. **Discussão:** Os achados do caso corroboram com o descrito na literatura consultada. **Conclusão:** O presente estudo se faz pertinente devido à escassez de estudos com mais participantes, com outras áreas da Fonoaudiologia que não somente a Audiologia.

Palavras-chave: Fonoaudiologia; Diabetes Mellitus tipo 1; Adolescência

Resumen

Introducción: la diabetes mellitus tipo 1 (DM1) se caracteriza por la destrucción de las células beta de los islotes pancreáticos, que se manifiestan en hiperglucemia sintomática, debido a un déficit absoluto de insulina, lo que genera una dependencia vital de la insulina exógena. Se considera típico en niños y adolescentes; sin embargo, puede desarrollarse a cualquier edad. Existen innumerables hallazgos de alteraciones auditivas en personas con DM1, pero no hay estudios en otras áreas de la Fonoaudiología. **Objetivo:** informar el caso de un adolescente con un diagnóstico reciente de diabetes mellitus tipo I y trastornos de fonoaudiología en el área del habla - desviación fonética en el fonema / r / - y procesamiento auditivo. **Caso clínico:** un adolescente de 11 años llega a Fonoaudiología por no poder realizar el /r/, con antecedentes de terapia del habla previa. Inmediatamente después de la evaluación del habla y el inicio del tratamiento, se sometió a un examen de procesamiento auditivo, que mostró cambios. Después de 30 sesiones de terapia del habla, el procesamiento auditivo se trató con éxito. **Discusión:** Los hallazgos del caso corroboran con los descritos en la literatura consultada. **Conclusión:** El presente estudio es relevante debido a la escasez de estudios con más participantes, con otras áreas de la Fonoaudiología brasileña además de la Audiología.

Palabras clave: Fonoaudiología; Diabetes mellitus tipo 1; Adolescente

Introduction

Diabetes mellitus is a chronic metabolic disease characterized by high blood glucose levels. This occurs because of an insufficient production of insulin by the pancreas or due to the inability of the body to use insulin in a proper way, leading the body to hyperglycemia.[1,2] The deficient action of insulin may occur due to a decrease in production by pancreatic beta cells; by a decrease in the response to insulin by the white tissues (insulin resistance), or by an increase in counter-regulating hormones opposed to the effects of insulin. Such factors determine the subclassifications of diabetes mellitus in type I and type II[2].

Type 1 diabetes mellitus (T1DM) is characterized by the destruction of the beta cells of the pancreatic islets, which manifests itself in symptomatic hyperglycemia, due to an absolute insulin deficit[2]. This generates a vital dependence on exogenous insulin. Its cause is 90% autoimmune and 10% idiopathic. It is considered typical in children and adolescents; however, its development may occur at any age[2]. It is the second most diagnosed chronic disease in childhood. The annual incidence of T1DM in Brazil is 8.4/100,000 inhabitants[1]. Brazil is the third country with the highest number of children and adolescents with type 1 diabetes mellitus, being the United States and India in first positions[3].

The clinical manifestations of diabetes mellitus are classified into acute and chronic complications.[2] Among the chronic complications are microangiopathy, neuropathy and macroangiopathy, which would be direct consequences of metabolic changes, specifically hyperglycemia.[2] Such complications may result in auditory changes, especially what concerns to the cochlear and neural level.[2]

There are some studies that researched hearing disorders in type 1 diabetes mellitus which found no statistically significant differences between hearing disorders in people with T1DM and people without diabetes. A study[2] investigated the decline in the acoustic reflex in people with type 1 diabetes mellitus, different ages (from 4 to 68 years old), with a diagnosis time ranging from one month to 44 years. From a sample of 46 people (92 ears), 15 people (30 ears) were children. The study concluded that the amount of pathological acoustic reflex was very low, with no difference between children and adults in the findings[2]. Such data corroborate with an epidemiological study[4] carried out with the objective of assessing the prevalence of hearing loss in people with T1DM. This study found no statistically significant differences between liminal tonal audiometry (response to pure tones between 0.5 and 8 KHz) of people with T1DM and people without T1DM. All people with T1DM were being treated and their blood glucose levels were controlled[4].

Despite the results previously reported, there are some studies that found hearing disorders in people with T1DM. A study[5] found changes in otoacoustic emissions per distortion product (fine structure) in young adults aged from 18 to 28 years with type 1 diabetes mellitus. Twenty young adults with T1DM were tested, with an average age of 22:6 years; and 20 young adults without T1DM as a control group, with an average age of 22:9 years. T1DM participants presented an average diagnosis time of 8.85 years, with no clinical history of neuropathy, nephropathy or retinopathy. From the entire audiological assessment performed on the participants (liminal tonal audiometry from 0.25 to 16 KHz, transient otoacoustic emissions and otoacoustic emissions per distortion product), only otoacoustic emissions per distortion product (fine structure) showed a statistically significant difference between the groups. This type of otoacoustic emissions suggests a probable onset of a cochlear pathology[5].

Another study[6] evaluated speech recognition in silence and in competitive noise, in the open field, in people with T1DM from 18 to 30 years old. Twenty people with T1DM and 20 people from the control group participated. The study found statistically significant differences between the performance in the sentence recognition threshold tests in silence and the sentence recognition threshold in noise, with the people with T1DM presenting worse results in the tests when compared to people without T1DM.

All studies presented so far have treated individuals with T1DM, being them adults and children[2] or adults only[4,5,6]. However, there is a study[7] that found functional hearing changes in 19 children and adolescents (mean age of 13.4 years) with type 1 diabetes mellitus. The study carried out liminal tonal audiometry with pure tones from 0.25 to 8 KHz, otoacoustic emissions by distortion product, brainstem auditory evoked potential (BAEP), functional assessment and response to a questionnaire on hearing and communication. The results of the study showed a slight decrease in hearing

thresholds in liminal tonal audiometry in children and adolescents with T1DM in comparison to the control group; mean amplitude of otoacoustic emissions by distortion product significantly decreased in the T1DM group; significant delay in the BAEP V wave, as well as delay in the interpeak of the III-V waves and in the interpeak intervals, which demonstrates a greater neural conduction time of the sound. The results of the functional evaluation, which verified the perception of binaural speech in noise in different positions, that is, the noise coming from one direction (for example 0º azimuth) and the speech sound from another (90º azimuth), demonstrated worse performance of the group with T1DM in relation to the control group. This demonstrates that children and adolescents with T1DM do not benefit from spatial cues to help with speech discrimination. The responses to the hearing and communication questionnaire corroborated the findings of the study, demonstrating that the group with T1DM presents twice as many difficulties with hearing and communication in their daily lives as their pairs without T1DM.

Based on the context of the research theme, the objective of the present study is to report the case of an adolescent with a recent diagnosis of type I diabetes mellitus and speech-language disorders in the speech area - phonetic deviation in the phoneme /r/ - and also in auditory processing. The following hypotheses were used to carry out the study: 1) The alteration in auditory processing may have contributed to the maintenance of phonetic disorders, as well as having an impact on the learning disorder of the student, especially in the neuropsychological attention function; 2) The auditory processing disorder may be part of T1DM, according to the literature review[6].

The hypotheses are justified based on the literature. Phonological disorder - including phonetic disorders - has a correlation with auditory processing disorder, especially in older children who continue with phonological disorder[8]. Regarding auditory processing disorder, which may impact learning, some studies[9,10] find high rates of children with auditory processing disorder and associated learning difficulties, reaching 88% of the sample of children with learning difficulties with auditory processing disorder[10].

Presentation of the case:

The adolescent[11] 'A' started attending the current speech therapy service at the age of 11, when he was in the 5th year of elementary school in a private school. He was referred by the psychologist, with whom he performs psychological monitoring for the treatment of issues inherent to the diagnosis of T1DM and its impact on quality of life, approximately one year before restarting speech therapy. The referral occurred due to the difficulty in pronouncing the phoneme /r/, verified in the phonological evaluation[12]. It was noticed that 'A' was unable to produce the phoneme /r/, replacing it in all possible occurrences: medial onset, medial and final coda and complex onset, by phonetic realization [Ò], which differ from each other by the following distinctive features: sounding, anterior, coronal, loud, preceding and voiced.

Chart 1. Matrix of distinctive features of phonemes[13]

Phonemes	Distinctive features
[Ò]	- sounding, - anterior, - coronal, + loud, + preceding, - voiced;
/r/	+ sounding, + anterior, + coronal, - loud, - preceding, + voiced

'A' is a fraternal twin, he was born a moderate premature infant of 34 weeks, with an appropriate weight for gestational age, and Apgar 6 and 9, respectively, with a head circumference of 31.5 cm. He passed the Neonatal Hearing Screening, being not necessary to stay in the ICU and he did not have any other particularities.

Regarding her clinical history, the mother reported that 'A' has already had previous speech therapy for language and speech delay, for about four years and often once or twice a week. In relation to hearing, the boy presented episodes of otitis media before one year of life, and with a new episode in the last year. The result of the

audiological evaluation requested in this speech therapy service was of normal hearing thresholds bilaterally and type A tympanometric curve[14] and ipsilateral and contralateral acoustic reflexes present. He reported hypersensitivity to loud sounds in the audiological anamnesis. In addition to speech therapy, 'A' has psychological care to deal with diabetic distress, which is the suffering inherent in all health care related to living with T1DM[15], which are the glycemic control, which consists of perforating the finger several times a day; the application of injectable insulin; the diet control - strict in the case of 'A' - and the regular practice of physical activity[16]. 'A' had psycho-pedagogical assistance restarted, since he had previous psychopedagogical assistance during school literacy, again presenting a complaint of learning difficulties, concomitant with the diagnosis of T1DM.

Approximately one year before the current speech therapy service, 'A' was diagnosed with diabetic ketoacidosis. That was the moment when 'A' and his family received the diagnosis of T1DM, he was nine years old. The family faced some difficulties at the beginning of the treatment to adapt to the new 'A' routine. Currently, 'A' has stable treatment. 'A' follows his health monitoring in order to control T1DM. The mother of 'A' is an active participant in support groups for parents of people with T1DM, as well as the student also participates in camps and groups for children and adolescents with T1DM.

Before the diagnosis of T1DM, 'A' was already a restless boy, with difficulties in socializing. 'A' maintains the pattern of restlessness, having improved sociability. In relation to school, his mother reported episodes of bullying due to the necessary care with T1DM. Bullying, in the case of the student, can act as a trigger for diabetic distress[15]. His classmates used to complain to the school team about the care inherent to T1DM, making fun of the student at times. This was the subject of speech therapy, where it was first proposed to the mother, and later, to the pedagogical team of the school, to carry out some work in the classroom on diabetes. However, the school did not want to discuss the topic with the academic community.

Still about the school, the mother mentions that her son has difficulties in the learning process, only getting good grades after family help in school activities, as well as psychopedagogical support. The learning difficulties of the student reappeared with the clinical diagnosis of T1DM and they were subsequently treated. In view of the psychopedagogical support, the written language was not addressed in speech therapy. 'A' also has the help of his sister, since they are classmates. It is not rare for the sister to pass on all the lesson content to her brother at home. Not long ago, the boy started to present behavioral changes, since all his hormonal clinical condition resulting from T1DM occurs in conjunction with the issues inherent to adolescence.

Considering that 'A' had a previous history of speech therapy for a long time (four years), without having resolved the phonetic deviation in previous speech therapy, associated with problems in present learning, even with psychopedagogical treatment; two months after the begining of speech therapy at this service, it was decided to request a specific assessment of auditory processing to verify if there would be any changes in this exam. A change in the auditory processing of the student might explain the learning difficulty, as well as the failure to overcome the phonetic disorder in previous speech therapy. At that time 'A', he was only 11 years old, and he also had an age criterion to adequately respond to the auditory processing assessment.

At 11 years and a month old, 'A' performed the auditory processing assessment. The following behavioral tests of peripheral and central auditory function were performed: Syntetic Sentence Identification (SSI)[17] ipsilateral (MCI)[17], Pitch Pattern Sequences (PPS)[18], Masking Level Difference (MLD)[19,20], Randon Gap Detection Test (RGDT)[20,21] and Dichotic Digits Test (TDD) [21]. As a result, changes were observed in the temporal ordering and resolution skills, and binaural separation and integration.

As part of the auditory processing assessment protocol, in view of the influence of auditory processing on reading comprehension[9], text comprehension was assessed using the Lacunado Test[9] and the Multiple Choice Test[9]; and phonological awareness with the Phonological Awareness test: Sequential Assessment Instrument - CONFIAS[22]. In the text comprehension assessment, 'A' scored above 60%, considered a good reader. In the Lacunado Test, he obtained 75.67% of correct answers, and in the Multiple Choice Test he obtained 100% of correct answers, presenting satisfactory performance in both. 'A' performed well at CONFIAS[22] in the two applications performed, the first at the

beginning of the speech therapy treatment for auditory processing and the other one month before the reassessment of auditory processing. The speech assessment[12] reported only phonetic disorders. The speech fluency[23] of the student was also assessed, being within the expected standards for his age. Thus, the 'A' speech therapy diagnosis was defined as "phonetic disorder associated with changes in auditory processing skills".

The auditory skills stimulation therapy included computerized and neurocognitive activities. The activities developed were performed using the Goffitunes software [24], activities with syllables, words, phrases, short and long texts, and lyrics. The work was also carried out through art therapy[25], where the boy worked with an auditory memory game, games of broad motor skills in which the boy had to perform movements when he heard a specific word or syllable in the music, such as clapping, clapping standing on the ground or jumping after hearing and identifying such an element in the song, and the game *"Quem? Onde? O que?"* for creating stories[25]. Thus, the skills stimulated were: attention, detection, discrimination, recognition and listening comprehension for verbal and non-verbal sounds, in addition to working with logical reasoning and executive functions[23].

Thirty sessions of phonotherapy were held, with weekly frequency and activities to be performed at home, once a day, with activities with the sounds of Goffitunes[24] and music, involving the auditory processing skills until the moment of the reevaluation. In the reassessment of auditory processing, 'A' overcame previously deficient skills. In speech, the student remains with the referred phonetic change, since the general therapeutic objective was to improve auditory skills. Initially, some speech issues associated with auditory processing were addressed. After the return of presential attendance, the focus was on auditory processing therapy, with the hypothesis that improving auditory processing would make it easier to treat speech. Currently, 'A' continues to perform speech therapy with a focus on speech.

In order to verify part of the learning of the spelling of the Portuguese Language, the balanced dictation of Moojen[26] was carried out, when the student was in the 6th year of elementary school. The student presented an error in a simple contextual rule, in the spelling of 'u' at the end of a syllable, before the syllable with 'r', in the word 'vassoura', spelled 'vassora'. This error is usually solved until the 7th grade for the social class of the student, considered medium-high due to the fact the student was studying in a private school and having all the resources available for studying. He also presented two errors of language irregularities, one being the change of X/CH and the other the spelling of S with the sound of Z with Z. Until this moment of correction, these errors are expected in the correction of the dictation for the social class and school year of the student. What drew the most attention in correcting the dictation was that the student was wrong in 100% of the accentuation events. However, accentuation errors have a greater number of errors per school year, have a less evident difference between social classes and they can remain until the end of elementary school, in view of the complex rules, especially of paroxytons[26]. This assessment was not carried out previously, as the student is undergoing psychopedagogical follow-up. The psychopedagogue reported that she was working on executive functions to assist academic acquisitions.

Discussion

The studied case is in agreement with the literature[4,6,7], especially in a study developed with children and adolescents with T1DM[7]. In the aforementioned study[7], it should be noted that liminal tonal audiometry had auditory thresholds within the normal standards[4,6,7], however the other tests showed changes, including the test that evaluates the perception of binaural speech[7], dealing with auditory processing. A study[6] also found changes in the sentence recognition threshold in silence and in the sentence recognition threshold in noise in adult individuals with T1DM, although participants with T1DM presented the other auditory assessments within normal standards.

The hearing skills of 'A' presented great improvement with the use of musical activities, which can be explained by the neurophysiological effects that music has on the human body[27]. The auditory cortex has three areas and each one is responsible for identifying and coding part of the information[27,28]. The auditory cortex of the left hemisphere is dominant for language, that is, verbal stimuli. The right hemisphere is dominant for environmental and musical sounds, that is, non-verbal stimuli[27,28].

The primary auditory area of the auditory cortex is responsible for identifying the features of the

sounds individually, as well as their location. The secondary auditory area of the auditory cortex is responsible for the integration of these individual sounds, grouping them into musical blocks, generating harmony, melody and rhythm[27-29]. The third auditory area of the auditory cortex is responsible for integrating the blocks into larger groups, forming musical concepts, creating interpretation, hierarchization and temporal organization. In this way, the musical composition is recorded in memory[27-29].

Musical activities activate the auditory cortex of the two cerebral hemispheres, stimulating the auditory skills bilaterally, providing binaural integration and motor coordination[27]. As movements were composing the musical activities of auditory processing therapy, it can be mentioned that these activities provide an effective and fun auditory training to clients[29].

Other areas of Speech, Language and Hearing Sciences, especially in relation to the language area, presented demand in the referred case report. 'A' arrived for speech therapy due to a complaint of phonetic disorder. From this complaint, demands arose in the areas of Audiology - the auditory processing disorder - and Educational Speech Therapy, in relation to learning difficulties and school bullying. Bullying can reinforce diabetic distress[15].

Distress, differently from stress, refers to the state of deterioration of the adaptive system, where the resources of the individual were not able to provide the adaptation, failing to reestablish the state of physical and mental homeostasis[30]. In the case of T1DM, to ensure good health conditions, the affected people have to perform care such as: glycemic control more than once a day, usually done with a lancet that pierces the finger, to collect blood in order to check capillary glycemia; use injectable insulin, depending on the case more than once a day; have a controlled diet; and maintain regular physical activity[16]. In the case of adolescents, glycemic control and the use of insulin should be given special attention, since hormonal changes make glycemia stabilization difficult[16]. All these routine changes negatively impact quality of life[16,30], which can cause diabetic distress[15], which is the suffering related to living with T1DM, in view of all the care inherent to self-management of T1DM[15].

In the present case, it is believed that there was an impact of the diagnosis of T1DM and its consequent care required on the quality of life of 'A', in agreement with what is described in the consulted literature[15,16]. In these studies[15,16], the studied populations answered the same questionnaire, the instrument of quality of life for young people with diabetes (IQVJD)[15,16]. In one study[16], the authors found that the more symptoms of depression, anxiety and stress the adolescent presents, the worse his quality of life becomes. This has been addressed in psychological counseling, for all the support that the student has from the family and during the speech therapy service provided to 'A'.

Conclusion

In the literature review, there is a lack of studies with children with T1DM and speech-language disorders. The present study, despite the limitations inherent in a case report, is pertinent due to the scarcity of studies with more participants, with other areas of Speech, Hearing and Language Sciences than just Audiology. The findings corroborate with the consulted literature, which advises that the population of people with T1DM perform other audiological assessments in addition to the basic audiological assessment. For future studies, it is recommended to insert quality of life questionnaires that address T1DM in adolescents who use Speech Therapy services, in order to find out how the care inherent in T1DM is. Studies with a population of children and adolescents, investigating demands on language and hearing are necessary to provide better care to this population. Speech therapy work with children and adolescents with T1DM demonstrated the need and efficiency, especially in hearing skills.

References

1. Malucelli DA, Malucelli FJ, Fonseca VR, Zeigeboim B, Ribas A, TrottaF, Silva TF. Hearing loss prevalence in patients with diabetes mellitus type 1. Braz J Otorhinolaryngol.[internet]. 2012 [acesso em 2020 ago 16]; 78(3): 105-15. Disponível em:https://reader.elsevier.com/reader/sd/pii/S1808869415302524?token=A7CDD26FE85F6F6A591B5F7AA9F5EF5B72368059F80B0626A4222AD2FC9E4BFCDA7E9DA18219DB7A409CD432C8BF0823

2. Quintana MJ, Peña E, Leyton J, Ianiszewski A. Deterioro del reflejo acústico en pacientes con diabetes mellitus tipo I. Rev. Otorrinolaringol. Cir. Cabeza Cuello. [internet]. 2014 [acesso em 2020 ago 16]; 74: 36-42. Disponível em: https://scielo.conicyt.cl/pdf/orl/v74n1/art06.pdf

3. Patterson C, Guariguata L, Dahlquist G, Soltész G, Ogle G, Silink M. Diabetes in the young - a global view and worldwide estimates of numbers of children with type 1 diabetes. Diabetes Res Clin Pract. [internet] 2014 [acesso em 2020 ago 16]; 103(2): 161-75. Disponível em: doi:10.1016/j.diabres.2013.11.005

4. Schade DS et al. Hearing Impairment and Type 1 Diabetes in the Diabetes Control and Complications Trial/Epidemiology of Diabetes Interventions and Complications (DCCT/EDIC) Cohort. Diabetes Care. [internet]. 2018 [acesso em 2020 ago 16]; 41(12): 2495-2501. Disponível em: https://doi.org/10.2337/dc18-0625.

5. Spankovitch C, Long GR, Hood L. Early indices of reduced cochlear function in young adults with type-1 diabetes revealed DPOAE fine structure. J Am Acad. Audiol. [internet]. 2019 [acesso em 2020 ago 16]; 30: 459-71. Disponível em https://www.thieme-connect.de/products/ejournals/pdf/10.3766/jaaa.17113.pdf

6. Silva BC, Mantello EB, Freitas MC, Foss MC, Isaac ML, Anastasio AR. Speech perception performance in subjects with type I diabetes mellitus in noise. Braz J Otorhinolaryngol. [internet]. 2017 [acesso em 2020 ago 16]; 83: 574-9. Disponível em: https://www.scielo.br/pdf/bjorl/v83n5/pt_1808-8694-bjorl-83-05-0574.pdf

7. Rance G, Chisari D, Edvall N, Cameron F. Functional hearing deficits in children with Type 1 diabetes. Diabet. Med. [internet]. 2016 [acesso em 2020 ago 16]; 33(9): 1268–74. Disponível em: https://onlinelibrary.wiley.com/doi/epdf/10.1111/dme.13086

8. Barrozo TF, Pagan-Neves LO, Vilela N, Carvallo RMM, Wertzner HF. The influence of (central) auditory processingdisorder in speech sound disorders. Braz J Otorhinolaryngol. [internet]. 2016 [acesso em 2020 dez 28]; 82: 56-64. Disponível em: http://dx.doi.org/10.1016/j.bjorl.2015.01.008

9. Costa-Ferreira MID, Sávio CB. Relação entre transtorno de processamento auditivo e dificuldades na compreensão leitora. Letrônica [internet] 2009.[acesso em 2020 ago 16] 2(1): 26-41. Disponível em: https://revistaseletronicas.pucrs.br/ojs/index.php/letronica/article/download/4815/4038/

10. Ribas A, Rosa MRD, Klagenberg K. Avaliação do processamento auditivo em crianças com dificuldades de aprendizagem. Rev. Psicopedagogia. [internet]. 2007 [acesso em 2020 dez 28]; 24(73): 2-8. Disponível em: http://www.revistapsicopedagogia.com.br/detalhes/354/avaliacao-do-processamento-auditivo-em-criancas-com-dificuldades-de-aprendizagem

11. Eisenstein E. Adolescência: definições, conceitos e critérios. Adolesc Saude. [internet]. 2005 [acesso em 2020 ago 16]; 2(2): 6-7. Disponível em: https://cdn.publisher.gn1.link/adolescenciaesaude.com/pdf/v2n2a02.pdf

12. Wertzner HF. Fonologia. In: Andrade CRF, Befi-Lopes DM, Fernandes FDM, Wertzner HF. ABFW – teste de linguagem infantil nas áreas de fonologia vocabulário, fluência e pragmática. Barueri: Pro-Fono, 2004. p. 5-31

13. Mota HB. Aquisição segmental do português: um modelo implicacional de complexidade de traços. Letras de Hoje. [internet] 1997 [acesso em 2020 ago 16]; 32(4): 23-47. Disponível em: https://revistaseletronicas.pucrs.br/ojs/index.php/fale/article/view/15290/10082

14. Jerger J. Clinical experience with impedance audiometry. Arch Otolaryngol. [internet] 1970 [acesso em 2020 ago 16]; 92(4): 311-24. Disponível em doi:10.1001/archotol.1970.04310040005002

15. Souza MA, Freitas RWJF, Lima LS, Santos MA, Zanetti ML, Damasceno MMC. Health-related quality of life of adolescents with type 1 diabetes mellitus. Rev. Latino-Am. Enfermagem. [internet] 2019 [acesso em 2021 jan 22]; 27: e3210. Disponível em: DOI: http://dx.doi.org/10.1590/1518-8345.2961.3210.

16. Greco-Soares JP, Dell"Aglio DD. Relações entre qualidade de vida e diabetes mellitus tipo 1 na adolescência. Contextos Clínicos. [internet] 2016 [acesso em 2021 fev 27]; 9(2): 159-167. Disponível em doi: 10.4013/ctc.2016.92.02.

17. Anastasio ART, Momensohn-Santos TM. Identificação de sentenças sintéticas (SSI) e reflexo acústico contralateral. Pró-Fono R. Atual. Cient. [Internet]. 2005 Dec [acesso em 2020 ago 17]; 17(3): 355-66. Disponível em: https://doi.org/10.1590/S0104-56872005000300009.

18. Engelmann L, Ferreira MIDC. Avaliação do processamento auditivo em crianças com dificuldades de aprendizagem. Rev. soc. bras. fonoaudiol. [internet]. 2009 [acesso em 2020 ago 17]; 14(1): 69-74. Disponível em: https://doi.org/10.1590/S1516-80342009000100012.

19. Martins QP, Faccin VA, Brückmann M, Gil D, Garcia MV. Masking Level Difference em escolares: análises ambientais. CoDAS [internet]. 2018 [acesso em 2020 Ago 17]; 30(3): e20170048. Disponível em: http://dx.doi.org/10.1590/2317-1782/20182017048.

20. Sanguebuche TR, Peixe BP, Garcia MV. Testes comportamentais em adultos: valores de referência e comparação entre grupos com e sem transtorno do processamento auditivo central. Rev. CEFAC [internet]. 2020 [acesso em 2020 ago 17]; 22(1): e13718. Disponível em: https://doi.org/10.1590/1982-0216/202022113718.

21. Peixe BP, Sanguebuche TR, Malavolta VC, Garcia MV. O estudo de respostas a testes de processamento auditivo em um grupo de idosos. Rev. CEFAC [internet]. 2019 [acesso em 2020 ago 17]; 21(6): e13818. Disponível em: http://dx.doi.org/10.1590/1982-0216/201921613818.

22. Moojen SMP. et. al. CONFIAS - Consciência fonológica: instrumento de avaliação sequencial. São Paulo: Casa do Psicólogo. 2003.

23. Andrade CRF. Fluência. In: In: Andrade CRF, Befi-Lopes DM, Fernande FDM, Wertzner HF. ABFW – teste de linguagem infantil nas áreas de fonologia vocabulário, fluência e pragmática. Barueri: Pro-Fono, 2004. p.51-81

24. Goffi-Gomez MVS. Goffitunes – Treinamento das Habilidades Auditivas: aspectos temporais do sinal acústico. Barueri: Pro-Fono. 2016. 1 CD ROM. Aplicativo.

25. Filippi C, Mezzomo CL. Terapia fonoaudiológica para gagueira utilizando linguagem teatral: dados preliminares. [internet]. 2019. [acesso em 2020 ago 17] Anais do XXVII Congresso Brasileiro de Fonoaudiologia. Belo Horizonte. Disponível em: http://www.sbfa.org.br/fono2019/checkout/trabalhos_select.php?id_artigo=11174.

26. Moojen SMP. A escrita ortográfica na escola e na clínica: teoria, avaliação e tratamento. São Paulo: Casa do Psicólogo, 2009.

27. Douglas CR. Neurofisiologia da música. In: DOUGLAS, R. Fisiologia aplicada a Fonoaudiologia. Rio de Janeiro: Editora Guanabara, 2006. p.183-91.

28. Alves WA, Rei TG, Boscolo CC, Donicht G. Influência da prática musical em habilidades do processamento auditivo central: uma revisão sistemática. Distúrb. Comum. [internet] 2018 [acesso em 2020 ago 17]; 30(2): 364-75. Disponível em: https://doi.org/10.23925/2176-2724.2018v30i2p-364-375

29. Engel AC, Bueno CD, Sleifer P. Treinamento musical e habilidades do processamento auditivo em crianças: revisão sistemática. Audiol. Commun. Res. [internet]. 2019 [acesso em 2020 ago 16] ; 24: e2116. Disponível em: https://doi.org/10.1590/2317-6431-2018-2116

30. Faro A. Estresse e distresse: estudo com a escala de faces em Aracaju (SE). Temas em Psicologia. [internet] 2015 [acesso em 2021 fev 27]; 23(2): 341-354. Disponível em DOI: 10.9788/TP2015.2-08.