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THE AUDITORY PROCESSING DOMAINS QUESTIONNAIRE AND THE AUDITORY BEHAVIOR SCALE IN INDIVIDUALS WITH AUTISM SPECTRUM DISORDER

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Mariana Buncana Simões Kanaan de Almeida[1], Jacy Perissinoto[2], Karin Ziliotto Dias[3] and Liliane Desgualdo Pereira[4]

ABSTRACT

Objective: To analyze everyday auditory skills perceived by parents or caregivers of individuals with Autism Spectrum Disorder (ASD) Level 1 and neurotypical individuals, using the Auditory Behavior Scale (SAB) and the Auditory Processing Domains Questionnaire (APDQ).

Methodology: An analytical cross-sectional study conducted at EPM-UNIFESP. A total of 93 individuals (aged 7 to 17 years) participated, divided into the ASD Group (ASDG) and the Neurotypical Group (NG). The SAB and APDQ questionnaires were applied to the caregivers, and central auditory processing (CAP) assessments were performed.

Results: The analysis of the SAB scores between the groups revealed a median of 53 points for the NG and 32 points for the ASDG, with a significant difference ($p<0.001$) and a medium effect size ($r=0.74$), indicating a considerable difference in auditory behavior between the groups. The APDQ instrument revealed statistically significant differences between the attention ($r=0.68$), language ($r=0.71$), central auditory processing ($r=0.73$), and total score ($r=0.73$) domains between the groups, with $p<0.001$. The NG obtained higher mean and median scores on all items compared to the ASDG, with effect sizes considered medium. In the central auditory processing domain, the NG had nearly double the median score compared to the ASDG.

Conclusion: The APDQ and SAB questionnaires were effective in the early identification of auditory, attention, and language difficulties, making them valuable tools in clinical and educational contexts. The combined use of the APDQ and SAB can assist in screening for CAP disorders, facilitating appropriate clinical referrals for children and adolescents with ASD Level 1.

Keywords: Auditory perception. hearing tests. autism spectrum disorder. auditory perception disorders. children and adolescents

[1] PhD Department of Speech, Hearing and Language Pathology, Universidade Federal de São Paulo, São Paulo, Brazil
[2] PhD Department of Speech, Hearing and Language Pathology, Universidade Federal de São Paulo, São Paulo, Brazil
[3] PhD Department of Speech, Hearing and Language Pathology, Universidade Federal de São Paulo, São Paulo, Brazil
[4] PhD Department of Speech, Hearing and Language Pathology, Universidade Federal de São Paulo, São Paulo, Brazil

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INTRODUCTION

Autism Spectrum Disorder (ASD) is characterized by difficulties in social interaction and communication, often associated with changes in central auditory processing (CAP), which can impair receptive language. It is believed that these difficulties arise from failures in the development of language precursors, including non-verbal communication. Sensory changes, such as auditory alterations, are common in children with ASD. Early diagnosis of auditory changes enables prompt interventions, which are crucial for the child's development, as neural plasticity is more robust during childhood [1].

CAP involves auditory processes such as sound localization and lateralization, auditory discrimination, and temporal perception. When these processes are impaired, it may be referred to as Central Auditory Processing Disorder [2]. Individuals with ASD often have difficulties processing speech in noisy environments, prosodic challenges, and issues with temporal processing[3]. Furthermore, they may report difficulties understanding speech in competitive situations, discomfort with sound stimuli (hyperacusis), or low reactivity to sounds[4]. These difficulties may also manifest in reading, writing, and academic performance issues[5].

The DSM-5 (2014) [6] classifies ASD into three levels of support: Level 1 (mild), Level 2 (moderate), and Level 3 (severe). Level 1 is characterized by communication and social interaction difficulties, with challenges in starting or maintaining conversations and understanding abstractions. However, the scarcity of studies on ASD can be attributed to the lack of conditions for therapeutic interventions, such as auditory training. CAP assessment is conducted through both subjective and objective tests, requiring adaptations for individuals with ASD due to interaction difficulties [7]. Questionnaires, such as the SAB (Scale of Auditory Behavior) and the APDQ (Auditory Processing Domains Questionnaire), have been studied as screening tools to identify individuals at risk of CAP alterations. Both assess auditory behaviors in everyday contexts and are completed by parents or caregivers. These questionnaires can identify auditory deficits and provide crucial information for diagnosis and treatment [8;9].

This study aims to explore the potential of the APDQ as a screening tool to assess CAP changes in individuals with ASD, also identifying possible predispositions to language or attention difficulties. It is expected that this approach will contribute to diagnoses and auditory rehabilitation programs, minimizing the impacts on child neurodevelopment.

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OBJECTIVE

To analyze everyday listening skills as perceived by parents or caregivers of individuals with ASD level 1 and neurotypical individuals, using the Scale of Auditory Behavior (SAB) and the Auditory Processing Domains Questionnaire (APDQ), created by Brian O'Hara and Kiri Mealings in 2018 and updated in 2020 (10,11).

METHODS

This is an analytical cross-sectional study. The research was conducted in partnership with the NIFTEA from the Department of Speech Therapy at EPM-UNIFESP, with data collection in school and speech therapy settings. The caregivers of the participants received detailed information about the tests and training involved. All caregivers were informed about the study's objectives and signed the Informed Consent Form, while the participants signed the Assent Form. The study adhered to ethical standards and guidelines for participation (approved under approval number 5.114.193).

The study included two groups: the ASD Group (ASDG), composed of children and adolescents with Autism Spectrum Disorder (ASD) level 1 support needs, and the Neurotypical Group (NG), composed of individuals without comorbidities. Inclusion criteria for the asdg were: diagnosis of ASD level 1 by a psychiatrist or neurologist, and for the NG: no neurodevelopmental delay and no diagnosis of Central Auditory Processing Disorder (CAPD). Both groups were required to have normal pure tone audiometry, speech audiometry, and tympanometry, as well as a low risk of cognitive impairment. Individuals with hearing impairment or a history of recurrent otitis were excluded. The final sample consisted of 93 individuals (ages 7 to 17) and their parents or caregivers.

Procedures were carried out to assess the participants' central auditory processing and two questionnaires were applied to the parents or caregivers to assess their perception of their children's auditory behaviors, attention, and language issues. The SAB (Scale of Auditory Behaviors) and APDQ (Auditory Processing Domains Questionnaire) were applied to the parents or caregivers, and a simplified Central Auditory Processing assessment, including the Duration Pattern Test, Dichotic Digits Test, RGDT, and PSI/SSI, was administered to the children and adolescents. The evaluations were performed in individual sessions lasting 45 to 60 minutes, with shorter sessions for the ASDG to minimize inattention. For the ASDG, between 3 and 5 sessions were conducted, while 2 sessions

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were sufficient for the NG. After the evaluation, an online feedback session was held with the caregivers to provide the results and individual reports.

The Auditory Processing Domains Questionnaire (APDQ) is an instrument consisting of 50 questions, divided into three domains: Attention, Language, and Central Auditory Processing. The questionnaire evaluates auditory concerns, sensitivity to loud sounds, and the ability to locate sounds, and is completed by the caregivers. The responses are processed in a spreadsheet that calculates scores and generates final reports with the percentage for each domain and the primary risk for each individual. The APDQ can indicate risks for Central Auditory Processing Disorder (CAPD) and Attention Deficit Hyperactivity Disorder (ADHD), as well as provide results on difficulties in listening, learning, and language. The instrument uses a scale adjusted to better differentiate scores, with a maximum of 116 points for CAP, 40 points for Attention, and 44 points for Language. The analysis is performed considering age groups (7-10 years and 11-17 years). The maximum total score for the questionnaire is 204 points, as one of the questions is not included in the sum of the domains, but is added to the total score. The software calculates secondary risks, such as deficits in auditory processing, attention, and language.

The APDQ questionnaire was translated into Brazilian Portuguese in the study by Braga Junior[12] by two speech therapists fluent in both languages. The final version, consisting of 50 questions, was evaluated by a committee of experts and non-experts who analyzed the instructions and the appropriateness of expressions using an adjusted Likert scale. Braga Junior et al.[13] ensured the cultural equivalence of the questionnaire for Brazilian Portuguese.

The SAB questionnaire consists of 12 items that assess auditory skills and their frequency of occurrence, with responses ranging from "frequent" (1 point) to "never" (5 points). The scores are summed, and the lower the score, the greater the indication of Central Auditory Processing Disorder (CAPD). The final score ranges from 12 to 60 points. The instrument uses a Likert scale of 1 to 5 to score auditory behavior. This questionnaire was developed by Nunes, Pereira, and Carvalho[14].

For the categorical variables in the sample, the data were represented by absolute frequencies (n), relative frequencies (%), and 95% Confidence Intervals (CI95%). Numerical variables were described using measures of central tendency (mean, median, minimum and maximum values) and dispersion (standard deviation [SD] and Interquartile Range [IQR]).

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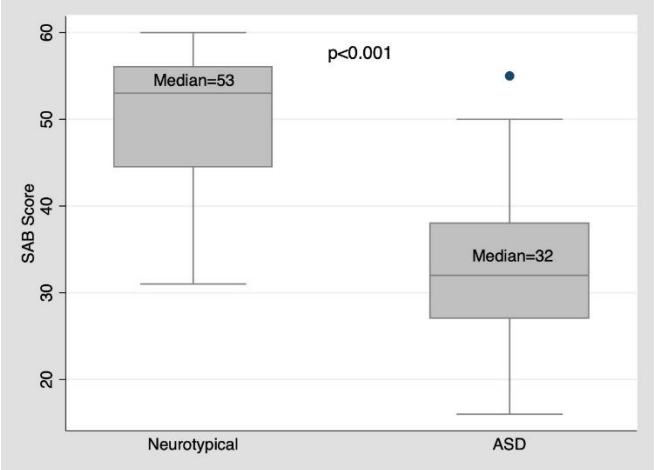
RESULTS

In this study, 93 parents/caregivers of children and adolescents participated. A total of 104 individuals agreed to participate in the study, of whom 93 met the inclusion and exclusion criteria. Neurotypical children and adolescents were invited, by convenience of the researcher, from students at a private elementary and secondary school. Those with ASD were invited, by convenience, from a network of professionals known to the researcher who work with individuals with ASD. Eight individuals who would participate in the neurotypical group due to having CAPD diagnosed by the researcher were excluded from the study, and three individuals who would participate in the ASD group due to being classified as needing level 2 support were excluded. Among the invited individuals who were not excluded, 93 participated. A single response from the parent/caregiver completing the APDQ was obtained per individual (child or adolescent). The respondents were grouped into two groups: the neurotypical group, which made up 51.61% of the sample, and the ASD group, which made up 48.38% of the sample. Additionally, it is important to note that in 100% of cases, the language used at school is the same as that used at home. It is also important to note that the APDQ separates responses by age group for analysis by the software, and therefore the age groups of the children and adolescents were distributed according to the APDQ.

When analyzing the SAB score between the groups, a median score of 53 points was found for the neurotypical group (NG) and 32 points for the ASD group (ASDG), representing a difference of 21 points. This difference between the groups was statistically significant and had a medium effect size (r=0.74) (p<0.001). Figure 1 illustrates the SAB score distribution for the NG and ASDG.

Table 1 shows the description of the APDQ domain scores and total scores according to the study groups.



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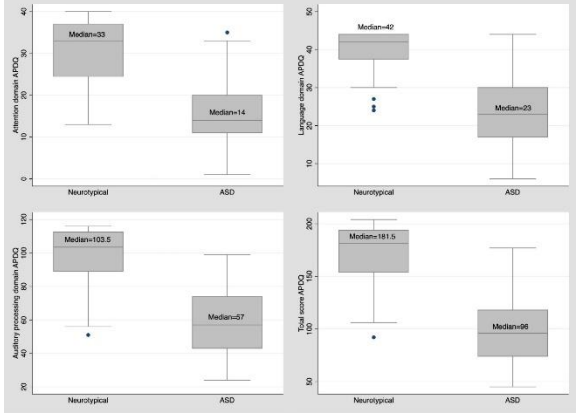
Variable	Neurotypical (n=48)			ASD (n=45)			p-value[a]
	Média (sd)	Median (IQR)	Min.-Max.	Mean (sd)	Median (IOR)	Min.-Max.	
SAB							
Total Score	50,4 (7,2)	53,0 (44,5-56,0)	31-60	32,7 (9,2)	32,0 (27,0-38,0)	16-55	**<0,001**
APDQ							
Attention Domain	30,2 (7,9)	33,0 (24,5-37,0)	13-40	15,7 (8,4)	14,0 (11,0-20,0)	1-35	**<0,001**
Language Domain	39,8 (5,4)	42,0 (37,5-44,0)	24-44	24,5 (9,5)	23,0 (17,0-30,0)	6-44	**<0,001**
Auditory Processing Domain	98,8 (16,4)	103,5 (89-112,5)	51-116	59,3 (21,7)	57,0 (43,0-74,0)	24-99	**<0,001**
Total Score	172,6 (28,0)	181,5 (154,0-194,0)	92-204	101,8 (37,0)	96,0 (74,0-118,0)	45-177	**<0,001**

Legend: SAB = Scale of Auditory Behavior; APDQ = Auditory Processing Domains Questionnaire; SD = Standard Deviation; IQR = Interquartile Range; ASD = Autism Spectrum Disorder; Min = Minimum; Max = Maximum.
[a] Mann-Whitney Test.

Table 1 provides more details about the SAB scores and APDQ domain scores between the groups. Regarding the APDQ instrument, a statistically significant difference was observed in the attention domain (r=0.68), language domain (r=0.71), central auditory processing domain (r=0.73), and total score (r=0.73) between the groups (p<0.001). The neurotypical group (NG) showed higher mean and median scores in all items when compared to the ASD group (ASDG), all with medium effect sizes. In the central auditory processing domain, GN showed almost double the median score (Med=103.5 points) compared to GTEA (Med=57 points) (p<0.001).

Figure 2 presents the APDQ scores for the groups graphically.



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DISCUSSION

This study evaluated the characteristics and results of the SAB [14] and APDQ [10,11] questionnaires in individuals with Autism Spectrum Disorder (ASD). The SAB, consisting of 12 questions about daily events, has a final score ranging from 12 to 60 points, with an average score of 46 points indicating typical auditory behavior for children aged 8 to 11 years. Scores below 35 points suggest the need for an auditory processing evaluation. The APDQ, validated by O'Hara & Mealings [10] and more recently adapted into Portuguese [13], allows the assessment of auditory, attention, and language skills, and is used by parents and educators to identify potential disorders in central auditory processing, ADHD, and language deficits.

In the study, 43 of the 45 participants with ASD (95.55%) presented CAPD, according to clinical evaluation. A comparative analysis of the APDQ and SAB questionnaire results revealed significant differences in the scores between the ASD and neurotypical groups. The GTEA obtained averages of 32 points on the SAB and 96 points on the APDQ, contrasting with averages of 53 and 181.5 points, respectively, in the control group. These findings indicate broader auditory and cognitive impairment in individuals with ASD, supporting previous studies [13; 15].

Furthermore, 42.1% of individuals with ASD were at risk for CAPD and ADHD, reflecting a high comorbidity rate, as evidenced by Pondé et al. [16]. Differences in the domains of attention, language, and auditory processing between the groups highlight the need for an integrated clinical approach, with interventions focused on early diagnosis and management of comorbidities asociated with ASD.

CONCLUSION

The use of questionnaires such as the APDQ and SAB has proven effective in the early identification of auditory, attention, and language difficulties, making them valuable tools in clinical and educational settings. The formation of multidisciplinary teams, including speech therapists, psychologists, and occupational therapists, is essential for the appropriate monitoring and treatment of individuals with ASD and their comorbidities.

The APDQ questionnaire has the potential to identify the risk of difficulties in daily auditory skills in individuals with ASD. This questionnaire, in conjunction with the SAB questionnaire, can be used as a screening tool to assess the risk of central auditory processing alterations in individuals diagnosed with ASD level 1, particularly those with

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families with high educational levels, in addition to identifying possible predispositions to risks in other outcomes, such as language or attention difficulties. Therefore, the use of the APDQ can be useful for making appropriate clinical referrals for individuals aged 7 to 17 with ASD level 1.

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