Original Article

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Translation and adaptation of the *Auditory processing domains questionnaire* into Brazilian portuguese

Tradução e adaptação do *Auditory processing domains questionnaire* para o português brasileiro

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Abstract

Purpose: to translate and adapt the Auditory Processing Domains Questionnaire to Brazilian Portuguese. **Methods:** this descriptive, exploratory, multicenter study translated and adapted the questionnaire in six stages: 1) translation by two bilingual Brazilian speech-language-hearing pathologists; 2) back-translation by an American English teacher and another bilingual speech-language-hearing pathologist, neither involved in the previous stage; 3) review and reduction, in which the researchers compared the 52-item with the current 50-item questionnaire; 4) expert committee with professionals in the field; 5) non-expert committee with the children's and adolescents' parents/guardians; 6) pilot study with a small sample with the characteristics of the instrument's target population. **Results:** the questions were carefully translated into the target language, with minimal changes that did not affect their content. Back-translation confirmed the accuracy without disparities in relation to the original version. The questionnaire review excluded two questions and modified 21 questions. The expert committee (nine speech-language-hearing pathologists with doctoral degrees) and the non-expert committee (30 parents/guardians) agreed on the formulation and understandability of the 50 questions. The pilot study applied the questionnaire to 30 participants, divided into a control group, a human communication disorder group, and an attention-deficit/hyperactivity disorder group. **Conclusion:** the translation ensured the cultural equivalence of the Auditory Processing Domains Questionnaire in Brazilian Portuguese.

Keywords: Auditory perception; Surveys and questionnaires; Hearing; Attention deficit disorder with hyperactivity; Child; Adolescent

Resumo

Objetivo: traduzir e adaptar o *Auditory processing domains questionnaire* para o português brasileiro. **Métodos:** foi realizado um estudo descritivo, exploratório e multicêntrico. O processo de tradução e adaptação do questionário foi feito em seis etapas: 1) tradução: realizada por duas fonoaudiólogas brasileiras, bilíngues; 2) retrotradução: realizada por uma professora de inglês americano e outra fonoaudióloga bilíngue, que não estiveram envolvidas na etapa anterior; 3) revisão e redução: comparação feita pelos pesquisadores do questionário de 52 questões com o atual, de 50 questões; 4) comitê de especialistas: composto por profissionais da área; 5) comitê de não especialistas: composto de responsáveis por crianças e adolescentes; 6) estudo-piloto: realizado em uma pequena amostra que refletisse as características da população-alvo do instrumento. **Resultados:** na tradução para o idioma-alvo, as questões foram cuidadosamente traduzidas com mínimas alterações que não afetaram seu conteúdo. A tradução reversa confirmou a precisão sem disparidades em relação à versão original. A revisão do questionário mostrou a exclusão de duas questões e a modificação de 21 questões. O comitê de especialistas, composto por nove fonoaudiólogas doutoras, e o comitê de não especialistas, composto por 30 responsáveis, concordaram com a formulação e compreensão das 50 questões. O estudo-piloto envolveu a aplicação do questionário em 30 participantes, divididos em grupo controle, grupo distúrbios da comunicação humana e grupo transtorno do déficit de atenção e hiperatividade. **Conclusão:** a tradução garantiu a equivalência cultural do questionário *Auditory processing domains questionnaire* para o português brasileiro.

Palavras-chave: Percepção auditiva; Inquéritos e questionários; Audição; Transtorno do déficit de atenção com hiperatividade; Crianças; Adolescentes

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INTRODUCTION

Central auditory processing disorder (CAPD) refers to changes in one or more auditory skills, which can impair listening, communication, and learning[1,2]. The current prevalence of CAPD in children is considerably important, with percentages varying in different populations[3-5].

Early CAPD identification in children helps diagnose and intervene, reducing school and social difficulties[2,6,7]. Therefore, ongoing research approaches screening methods for early CAPD identification in at-risk individuals[8,9].

Guidelines indicate several instruments, such as scales, questionnaires, and hearing test batteries, to screen and detect possible risks and/or behavioral manifestations related to CAPD. These tools are decisive in screening auditory skills in the most diverse study populations. The documents state that questionnaires provide information about auditory behavior and its impact on communication, academic, and work performance. They are strongly suggested in clinical practice for early identification and intervention in children at risk for CAPD[2,6,7,10].

Several questionnaires in the international literature investigate auditory skills, with excellent psychometric characteristics and great potential to detect individuals likely to have CAPD – e.g., Children's Auditory Performance Scale (CHAPS)[11], Listening Inventory for Education (LIFE)[12], Speech, Spatial and Qualities of Hearing Scale (SSQ)[13], and Evaluation of Children's Listening and Processing Skills (ECLiPS)[14].

Questionnaires for children can also be found in the Brazilian literature. Some the authors developed but did not validate, others they translated and validated, and yet others were only translated, without data on the instrument's validation in a significant sample of different populations. These instruments include the CHAPS[11], the Scale of Auditory Behaviors (SAB)[15], and the Auditory Processing Domains Questionnaire (APDQ)[16].

APDQ was initially developed with 52 questions to help diagnose CAPD and distinguish individuals with CAPD from those with other comorbidities[16]. The study gave the instrument prominence due to its methodological rigor and adequate sensitivity and specificity, being indicated for research[17,18]. Although recommended in the international literature, few studies have used the APDQ[19-22]. At the national level, a single study showed that the translation of the APDQ has internal validity and favorable reliability[22].

However, the author of the questionnaire changed the wording of some questions and proposed removing two questions from the APDQ, reducing it to a 50-item version[23]. However, no study has been conducted to date in Brazil with this new version. The literature highlights that changes to the original questionnaire can impact interpretation, compromising the validity of the data collected. Therefore, it is essential to review the translation to ensure that the changes are duly reflected in the new Portuguese version. The need for a new questionnaire translation considering the changes made to the original version is justified by the importance of maintaining fidelity to the updated content[24].

In recent years, there has been a significant increase in the translation and cross-cultural adaptation of international instruments, enabling their use in different cultures, and ensuring that the data accurately reflect what they are intended to measure. It also enables data comparison across different cultures, thanks to the use of standardized instruments[25,26].

Questionnaires assessing schoolchildren's behavior characterize their auditory and clinical behavior in different environments[15,17]. Thus, the process of translating and adapting the APDQ to other languages, including Brazilian Portuguese, expands its clinical applicability, complementing the behavioral assessment[16].

Since the APDQ differs aspects of attention and language, it is expected to bring great clinical and scientific contribution, assisting in the screening, diagnosis, and rehabilitation of children with CAPD. Thus, this study aimed to translate and adapt the APDQ to Brazilian Portuguese.

METHODS

This descriptive, exploratory, multicenter study involved the Federal University of Santa Catarina (UFSC), the Federal University of São Paulo (UNIFESP), and the Center for Speech-Language-Hearing Studies (NESF), in São Paulo. It was approved by the Human Research Ethics Committee of both universities, under number 5.268.520. All parents/guardians of the children and adolescents signed an informed consent form specific to the legal guardians of minors, authorizing their participation in the research. Minors were asked to sign an informed assent form.

Instrument's translation and adaptation

Currently, there are a variety of translation and cross-cultural adaptation strategies, and it is essential to value all stages to reduce errors and preserve the original characteristics of the instruments, which may otherwise be lost in the process[27,28]. This study translated and adapted the APDQ in six stages: 1) translation, 2) back-translation, 3) review and reduction of the questionnaire, 4) experts committee, 5) non-experts committee, and 6) pilot study. All stages followed the recommendations of studies in the area[25]. It was not necessary to request additional authorization from the author of the questionnaire, as it had already been granted in a previous study[22].

Stage 1: Translation

The APDQ questions modified in the reduced English version were translated into Brazilian Portuguese by two independent bilingual Brazilian speech-language-hearing pathologists, aware of the research objective. The translators and study coordinators compared the two translations and, in case of discrepancies, modified them until a consensus translation was reached.

Stage 2: Back-translation

The translated version was back-translated (from Portuguese into English) by an American English teacher and a bilingual speech-language-hearing pathologist, who were not involved in the previous stage. The two English versions were then compared with the original instrument to ensure an accurate translation, culminating in a new version of the questionnaire in Portuguese.

Stage 3: APDQ review

After the new questionnaire version in Portuguese, the researchers compared the current 50-question with the previous 52-question APDQ to identify which questions were modified and which were deleted.

Stage 4: Expert committee

An invitation letter was sent to professionals via email, explaining the research objectives, and inviting them to participate in the expert committee. The version resulting from satisfactory agreement between the authors was sent to the expert committee to examine linguistic and cultural similarity.

The 50 APDQ questions were evaluated using a Likert scale from 0 to 5, with 0 indicating "completely disagree" and 5 indicating "completely agree". The objective was to evaluate the questionnaire instructions and the adequacy of the expressions in the items. Questions with mean scores equal to 4 and 5 were considered adequate, while those with scores lower than 3 were considered inadequate and required rewriting.

Stage 5: Non-expert committee

After analysis by expert judges, the 50-item questionnaire was evaluated by non-expert judges – i.e., parents/guardians of children and adolescents. They were invited to participate in the research and join the panel of non-expert judges, assessing whether the instructions were understandable, whether the terms in the items were appropriate, and whether the expressions corresponded to those used by the instrument's target audience. They were invited via text messages disseminated in message groups and e-mails, explaining the research objectives.

The 50 APDQ questions were evaluated using a Likert scale from 0 to 5, with 0 indicating "completely disagree" and 5 indicating "completely agree". Questions with mean scores of 4 and 5 were considered adequate, while questions with means lower than 3 were considered inadequate and required rewriting.

Stage 6: Pilot study

Participants

A prospective study was conducted on a small convenience sample that reflected the characteristics of the instrument's target population. The pilot study sample had the following groups:

- Control group (CG): consisting of typically developing individuals not diagnosed with CAPD, with no complaints in the medical history survey, SAB[15], and SNAP-IV (Swanson, Nolan, and Pelham Rating Scale)[29]. The researchers recruited them through an electronic form published on social networks and messaging groups.
- Human communication disorders group (HCDG): consisting of individuals diagnosed with CAPD and with speech, reading, and/or writing disorders reported by the parents/guardians in the medical history survey and the SAB[15] and SNAP-IV[29] scores. They were recruited from two institutions in Southeastern Brazil, an outreach program, and the internship of a speech-language-hearing course in Southern Brazil.
- Attention-deficit/hyperactivity disorder group (ADHD) (ADHDG): consisting of individuals diagnosed with ADHD and with complaints reported by their parents/guardians in the medical history survey and the SAB[15] and SNAP-IV[29] scores. They were recruited through a research partnership with the pediatric outpatient clinic of a university hospital in Southern Brazil. They underwent a multidisciplinary evaluation that included a neuropsychological battery to measure linguistic and cognitive skills, such as the WISC-V test (Wechsler Intelligence Scale for Children)[30], administered by a psychologist, and a battery of tests performed by the speech-language-hearing and pedagogy team. A pediatrician and a psychiatrist also evaluated them. After diagnosis, the lead researcher invited those who met the inclusion criteria to participate in the study.

Inclusion and exclusion criteria

The inclusion criteria for the groups were individuals aged 7 years to 17 years and 11 months, of both sexes, having Brazilian Portuguese as their first language, absence of middle ear pathologies, and hearing thresholds within normal standards bilaterally[31].

The CG included individuals with no childhood history of middle ear disorders, good school performance reported by parents/guardians in the medical history survey, and no diagnosis of dyslexia, ADHD, or any other neurodevelopmental disorder reported in the same survey. They performed a minimum behavioral test battery – the behavioral assessment of central auditory processing (CAP) should indicate adequate auditory skills[32]. CG participants should also have a total SAB score greater than or equal to 46 points[15], and they could not have six or more items marked as "quite a lot" or "too much" in SNAP-IV items 1 to 9 and 10 to 18[29].

The HCDG included individuals with CAPD with abnormal results in at least one of the CAP tests in the minimum battery[32]. Their parents/guardians reported issues related to some human communication disorder (oral and/or written language disorders) other than ADHD in the medical history survey. To eliminate signs and symptoms suggestive of ADHD, only individuals whose SNAP-IV scores were not greater than or equal to 6 in questions 1 to 9 and 10 to 18[29] were included in the HCDG. They should also have a SAB score lower than 46 points[15].

The ADHDG group consisted of individuals with a multidisciplinary diagnosis of ADHD (being inattentive, hyperactive, or both), and who had some human communication disorder, as reported by their parents/guardians in the medical history survey. It included individuals whose SNAP-IV scores were greater than or equal to 6 points in questions 1 to 9 and 10 to 18[29] and whose SAB scores were lower than 46 points[15]. All individuals had the diagnosis confirmed through the multidisciplinary evaluation and were medicated – although not being medicated by the doctor was not an exclusion criterion.

The exclusion criteria for all groups were neurological changes reported by their parents/guardians in the medical history survey and/or evident cognitive changes observed by evaluators.

Instrument

The APDQ identifies risks for children and adolescents based on their parents/guardians' responses. It has a field for the participant's identification data, personal data, the parents/guardians' data, risk factors, and three preliminary questions: 1 - "Please indicate the degree of your concern about the student's hearing abilities"; 2 - "Please indicate the child's sensitivity/stress reaction to loud sounds and noisy environments"; 3 - "Please indicate the child's difficulty in locating sounds". The questionnaire takes approximately 30 minutes to complete.

It has 50 questions grouped into three domains: auditory processing with 29 items (questions: 3, 4, 5, 8, 9, 10, 11, 12, 14, 17, 20, 21, 22, 26, 31, 32, 33, 34, 35, 37, 38, 41, 42, 43, 44, 45, 47, 49, and 50), attention with 10 items (questions: 1, 3, 6, 13, 16, 19, 23, 28, 30, and 40), and language with 11 items (questions: 7, 15, 18, 24, 25, 27, 29, 36, 39, 46, and 48). Question 3 addresses CAPD and ADHD information; therefore, it is present in both domains. The questionnaire has a fourth scale called Targeted Auditory Processing, with 18 items on auditory decoding among the 29 items of the auditory processing domain (questions: 5, 8, 9, 10, 11, 12, 20, 22, 26, 31, 32, 33, 34, 35, 37, 47, 49, and 50).

Each question has five answer options with the following scores:

- 4 points for behavior that occurs almost always.
- 3 points for frequently.
- 1 point for sometimes.
- 0 points if the behavior rarely occurs.
- "Not applicable" does not score, and the question is excluded from the final calculation.

Questionnaire items 16, 17, 21, 22, 30, and 35 have inverse scores, that is:

- 4 points for behavior that occurs rarely.
- 3 points for sometimes.
- 1 point for frequently.
- 0 points if the behavior occurs almost always.
- "Not applicable" does not score, and the question is excluded from the final calculation.

The final questionnaire score is calculated with the following Equation 1.

$$Score = \frac{points\ obtained\ in\ the\ questions\ of\ the\ domain}{4 \times maximum\ number\ of\ points\ in\ the\ domain} \times 100 \quad (1)$$

The maximum score per domain is 116 for auditory processing (29 questions), 40 for attention (10 questions), and 44 for language (44 questions), totaling 200 points for the 50 questions, suggesting the absence of a possible risk for neurodevelopmental disorders.

The APDQ is accompanied by a Microsoft Excel spreadsheet, called Database, available on the questionnaire author's website, along with a manual[23]. The spreadsheet was programmed to calculate and generate the final report, indicating each person's percentage per domain and their primary risk, such as: High risk of CAPD; Risk of CAPD; High risk of ADHD; Risk of ADHD; Combined risk of CAPD and ADHD; Difficulties in listening, learning, and language; Language deficits and normal hearing.

The questionnaire differs each person's possible risks based on two criteria:

1) The cutoff point for each domain indicates whether the individual is at risk or not. The questionnaire uses the cutoffs established in the original study, which defined the percentages and percentiles of risk for changes through statistical analyses such as the Receiver Operating Characteristic Curve (ROC Curve) and linear regression. In this study, external validity analyses using the linear regression model revealed significant differences between the typically developing group and the clinical groups in all scales ($p < 0.001$), with also significant differences between the three clinical groups evaluated. The ROC Curve identified cutoffs with levels of 80% to 90% for sensitivity and specificity[16]. The values are organized in Table 1.

2) The difference between the attention and auditory processing domains helps distinguish the person's risk. The difference between these scores suggests the following risks:

- Scores equal to or above 0: If the difference between scores in the attention and auditory processing domains is equal to or greater than 0, it indicates that the person may be facing auditory processing difficulties.
- Scores between -1 and -8: If the difference between the attention and auditory processing domain scores is between -1 and -8, it may indicate combined risk factors for CAPD and ADHD.
- Scores below -9: If the difference between the attention and auditory processing domain scores is less than -9, it is a sign that the individual may be at risk for ADHD.

Primary language risk is a special case because individuals classified as such must have a score equal to or less than 45% (below the 3rd percentile). This blocks the primary risks of CAPD and/or ADHD because these risks require a sufficient score in the language domain. The author explains that ADHD

Table 1. Percentages and percentiles of the risk for changes in the Auditory Processing Domains Questionnaire

Percentile	Age group	Auditory processing	Attention	Language
15th to 20th Lower risk	7 to 10 years	≤ 70%	≤ 60%	≤ 80%
	11 to 17 years	≤ 78%	≤ 67%	≤ 84%
5th to 10th Greater risk	7 to 10 years	≤ 56%	≤ 42%	≤ 72%
	11 to 17 years	≤ 62%	≤ 53%	≤ 78%

Caption: ≤ = less than or equal to

and CAPD cannot be diagnosed in individuals with significant language impairment – both diagnoses require language without deficits[16,23].

Table 2 summarizes the percentiles needed for the questionnaire to differentiate individuals at each of the eight possible APDQ risks.

Criteria 1) and 2) are the same as those in the original questionnaire study[16,23] since no studies in Brazil have yet presented specific values for Brazilian children and adolescents.

APDQ application

The researcher administered the questionnaire to the participants' parents/guardians, taking care not to interfere with their responses. It was also ensured that the APDQ respondent was preferably the participant's mother, father, or at least one of the main caregivers, as substantial knowledge about the child is needed to respond to the questionnaire, ensuring a more accurate and well-founded response. The questionnaire was answered, and the evaluator entered the data into the Database spreadsheet.

The "ID" is entered on the APDQ home screen, indicating the person's identification number, the date when the questionnaire was completed, and the person responding to it – the mother, father, teacher, or other person. The participant's information is filled in in the next section, with the date of birth, sex, whether they have difficulty localizing sounds, sensitivity and/or stress to noise, and the parent/guardian's level of concern with the child's hearing difficulties.

It is also necessary to indicate the risk factors (if the child has any), such as A - Special Education; B - Learning Difficulty; C - Specific Language Disorder; D - Dyslexia; E - Hearing Loss; F - History of speech delay; G - Otitis and/or middle ear surgery; H - Jaundice at birth; I - Portuguese as a second language; J - ADHD; K - CAPD; L - Autism Spectrum Disorder; M - Developmental delay/Intellectual disability. After filling in these items, the respondent answers the 50 APDQ questions that define the score, then transposed to the spreadsheet (Figure 1 – A and B).

Statistical analysis

The data for the categorical variables of the sample were represented by means of absolute (n) and relative (%) frequencies. The numerical variables were described through measures of dispersion (mean, standard deviation [SD], and median).

RESULTS

Translation and back-translation

The reduced and translated APDQ version comprised the 50 questions proposed in the original version, grouped into three domains: auditory processing, attention, and language. The questions that had undergone minor wording changes in the original version were carefully translated into the target language, with minimal modifications that did not affect the formulation or content of the questions. These changes did not compromise the APDQ translation because no disparities were identified in the terms and meaning of the questions compared to the original English version in the back-translation.

APDQ review and reduction

The changes made by the questionnaire author involved the removal of two questions: "13 – The child can look and listen correctly at the same time - checking a page or the blackboard and taking notes (if older)" and "37 – The child understands instructions in noisy environments when paying close attention to the speaker". With these changes, the questionnaire was reduced to 50 questions. The changes are shown in Chart 1.

The author also changed the wording of 21 questions. These were mainly simplified wording: removal of qualifiers or additional explanations, as in question 4; changes in the description of examples: inclusion or exclusion of specific examples, aiming to better illustrate the situations, as in question 11; adjusted description of behaviors: more precise observed behaviors, as in question 39; change in the structure at the beginning of the question: some questions that previously began with a negative were changed to an affirmative construction, such as question 4.

Expert committee

The expert judges' committee was made up of nine speech-language-hearing pathologists, all with PhDs, five of

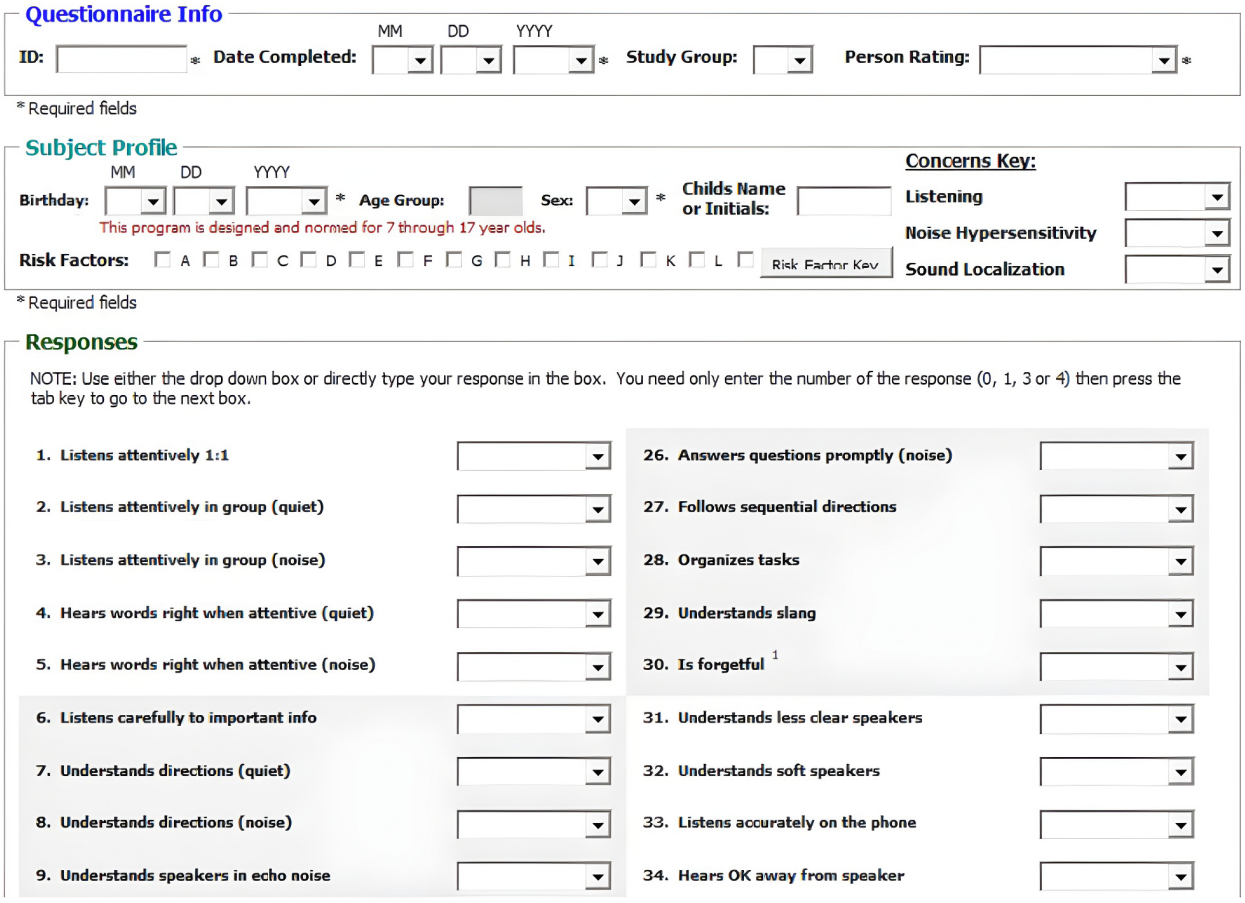
Table 2. Summary of the percentiles needed to differ risks, as proposed by the Auditory Processing Domains Questionnaire

Primary risk	Percentile			Difference between ATT and AP
	AP	ATT	LGG	
High risk of CAPD	≤ 5th	-	≥ 3rd	≥ 0
Risk of CAPD	≤ 15	-	≥ 3rd	≥ 0
High risk of ADHD	-	≤ 10* / ≤ 5**	≥ 3rd	≤ -9
Risk of ADHD	-	≤ 20	≥ 3rd	≤ -9
Combined risk of CAPD and ADHD	≤ 15	≤ 20	≥ 3rd	-1 to -8
Hearing, learning, and language difficulties	-	-	≤ 3rd	-
Language deficits	-	-	3rd to 15th	-
Normal hearing	> 15th	> 20	>15	-

*Percentile suggested for younger individuals (7 to 10 years). ** Percentile suggested for older individuals (11 to 17 years)

Caption: AP = Auditory Processing; ATT = Attention; LGG = Language; CAPD = central auditory processing disorder; ADHD = attention-deficit/hyperactivity disorder; > = greater than; ≤ = less than or equal to; ≥ = greater than or equal to

a)



b)

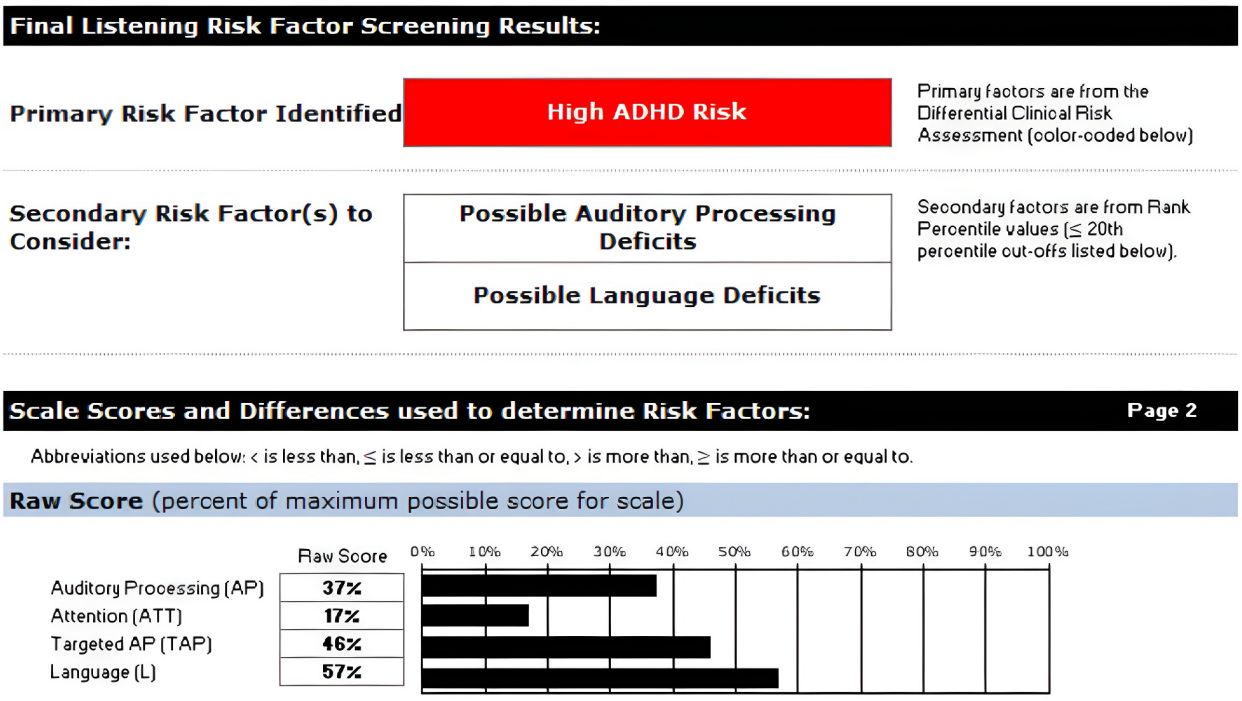


Figure 1. Database spreadsheet of the Auditory Processing Domains Questionnaire: A) Screen for inserting patient data into the questionnaire's Excel spreadsheet; B) Final report generated by the Excel spreadsheet with the percentages between the domains and the primary risks (outcomes)

Chart 1. Summary of the modifications to the Auditory Processing Domains Questionnaire

Previous wording of the questions (52-question APDQ)	Current wording of the questions (50-question APDQ)
4. The child has no difficulty hearing your words correctly when they pay close attention in quiet environments.	4. The child hears your words correctly (without repetitions) when paying attention in quiet environments.
5. The child has no difficulty hearing your words correctly when they pay close attention in noisy environments.	5. The child hears your words correctly (without repetitions) when paying attention in noisy environments (where other people may be talking at the same time).
7. The child understands spoken instructions when the environment is quiet.	7. The child understands instructions when paying attention in quiet environments.
8. The child understands spoken instructions when the environment is noisy.	8. The child understands instructions when paying attention in noisy environments.
11. If interested, the child hears you correctly while doing something else (video games, small tasks, watching TV, etc.).	11. The child can hear you correctly while doing something else (e.g., video games or small household chores).
17. The child does not get tired easily when studying (yawns or plays with hands - consider age).	16. The child gets tired easily when studying (yawns or plays with hands).
18. The child does not get tired easily when listening (yawns or plays with hands – consider age).	17. The child gets tired easily when listening (yawns or plays with hands).
20. The child focuses on tasks even if they are not urgent or very interesting (to them).	19. The child focuses on important tasks even if they are not fun or interesting.
22. The child does not say “huh?”, “what?” or need repetitions when talking with interest in quiet environments.	21. The child says “what?” or needs repetition when talking with interest in quiet environments.
23. The child does not say “huh?”, “what?” or need repetitions when talking with interest in noisy environments.	22. The child says “what?” or needs repetition when talking with interest in noisy environments.
31. The child does not miss or forget to do daily activities (is not absent-minded).	30. The child misses or forgets to do things (is absent-minded).
33. The child understands speakers’ soft or loud voices.	32. The child understands speakers with soft or high-pitched voices (shy people – children’s voices and some female voices).
36. The child does not mishear or confuse words that sound similar (like “*faca*” and “*vaca*”, “*sessenta*” and “*setenta*”).	35. The child hears words incorrectly or confuses words that sound similar (like “*faca*” and “*vaca*”, “*sessenta*” and “*setenta*”).
39. The child can correctly make the sounds that form a word to help with spelling (as expected for age).	37. The child can pronounce new words correctly after hearing them a few times (including names of people and places).
40. The child can make the sounds that make up a word and speak unfamiliar words correctly when learning to read them (as expected for age).	38. The child can recognize the sounds of letters and establish the correspondence between letters and writing to help them read and write the word correctly (as expected for age).
41. The child can read and understand stories at a good speed (as expected for age).	39. The child reads at a good speed (as expected for age).
45. The child readily follows rhythmic and intonation patterns when playing music by clapping, humming, etc.	43. The child follows rhythmic and intonation patterns by clapping, drumming, or humming with others.
47. The child recognizes “how” things were said by interpreting comments and following instructions (notices different tones of voice, emphasis on key words, etc.).	45. The child perceives “how” things were said when interpreting comments and following instructions (notices different tones of voice, emphasis on key words, etc.).
50. The child can speak easily and without problems, for age (without using “huh” or pausing to find words and ideas).	48. The child can speak easily and fluently for age (without forgetting words or using too many pauses).
51. The child hears people well without having to control “extra” noises (pays attention even without having to turn off the radio or machines, close windows, change places, etc.).	49. The child understands conversations and instructions without having to control “extra” noises (e.g., turning off the TV, closing windows, changing seats).
52. People rarely need to speak more slowly and clearly to help the child hear correctly.	50. The child understands people without needing them to speak more slowly or more clearly.

Caption: APDQ = Auditory Processing Domains Questionnaire

whom were specialists in audiology, all with at least 10 years of experience, linked to teaching and research institutions in different regions of Brazil.

Of the 50 questions analyzed by the committee of expert judges, 45 averaged 5 points (“I totally agree”), and the other five (2, 4, 5, 17, and 40) averaged 4 points (“I agree”).

Non-expert judges committee

The committee of non-specialist judges was formed by 30 parents/guardians, equally distributed among those with elementary, secondary, and higher education. Among them, 22 were mothers and eight were fathers. Their children’s mean age was 11 years (SD = 3.12; Minimum = 7 years; Maximum = 16 years). All 50 questions averaged 4 points (“I agree”).

The responses from both committees indicated agreement with the formulation and understandability of the 50 questions’ writing, resulting in the final version of the APDQ with 50 questions in Portuguese (Annex 1).

Pilot study

In the questionnaire application stage, 30 individuals were selected and divided into three groups, each with 10 participants.

Most participants (66.66%) were 10 to 17 years old (young children), males (60%), and attended 5th grade (40%).

In the CG, 80% of the mothers and 70% of the fathers had higher education. In the HCDG, 40% of the fathers had higher education and another 40% had secondary education, while 50% of the mothers had higher education. In the ADHDG, 50% of the mothers and 50% of the fathers had only secondary education.

In the CG, 50% were males and had a mean age of 10 years (Minimum = 7; maximum = 16; SD = 2.6). The HCDG was composed of 60% males with a mean age of 10 years (Minimum = 7; maximum = 13; SD = 1.6), and the ADHDG had 70% of males and a mean age of 9.4 years (Minimum = 7; maximum = 11; SD = 1.4).

The CG had a higher mean total APDQ score than the HCDG and ADHDG, the latter having the worst performance (Table 3).

The APDQ domain scores per group had the same configuration as that of the total score – the CG had the highest score, followed by the HCDG and the ADHDG. Also, the CG had higher percentages than the other study groups, and these had percentages that indicate a risk of change, considering the cutoff (Table 4). Furthermore, the groups' scores and percentages differed the CG participants (without auditory processing changes) from those of the study groups (with auditory processing changes).

DISCUSSION

The cross-cultural adaptation of research instruments has gained increasing prominence in health research, enabling the development of new tools for scientific advancement[25,26]. The APDQ has great potential for clinical use because it identifies individuals at risk of changes and distinguishes their risks, guiding the professional's practice[16].

The questionnaire had been previously translated. However, after the modifications made by the author, it was necessary to retranslate it. The process involved the analysis of professionals who were experts in the field and fluent in English to verify the adequacy of the content during the translation and adaptation, making only the necessary adjustments.

The changes made by the author facilitated its comprehension, making some questions simpler and others more detailed, providing the respondent with clearer contexts. One positive point was the change in the wording of some questions, which removed the "no" from the beginning. This change helps to prevent the questions from focusing on difficulties and inducing answers, focusing instead on the individual's real ability.

The members of the panel of expert and non-expert judges were carefully chosen. The panel of expert judges included professionals with expertise in audiology and experience in teaching, resulting in a careful analysis of the questions. The panel of non-expert judges included parents/guardians of children representing the three main education levels, with a balanced distribution between them to obtain a comprehensive analysis of the formulation and writing of the questions – especially by parents/guardians with elementary education since they are at greater risk of having children with CAPD[33].

Studies that address adaptation cite the need to modify questions or statements of instruments as they are translated into another language, due to the influence of cultural differences, especially concerning specific conditions[26,27]. However, no modifications were necessary in this study; neither panel encountered difficulties in understanding the sentences. The participants understood all questions, thus ensuring the cultural equivalence of the questionnaire. The APDQ proved to be easy to understand and clinically applicable, as evidenced in the literature. It is believed that its Portuguese version will contribute to the early identification of students at risk of developing CAPD.

The APDQ has three domains, whose scores are added together to calculate the total score, which determines the percentage, percentile, and primary risk. This study's analyses included

Table 3. Descriptive analysis of the total score per group in the Auditory Processing Domains Questionnaire

Group	Mean	Median	Minimum	Maximum	Standard deviation
CG	184.3	186	178	195	8.7
HCDG	117.5	124	61	157	28.36
ADHDG	84.88	82	66	128	23.16

Caption: CG = control group; HCDG = human communication disorder group; ADHDG = attention-deficit/hyperactivity disorder group

Table 4. Descriptive analysis of percentages and scores per group in the domains of the Auditory Processing Domains Questionnaire

Groups		AP	ATT	LGG
CG	**Mean**	103.5	35.2	42
	Median	103.5	35	42
	Min - Max (SD)	94 - 112 (6.5)	34 - 39 (2.4)	37 - 44 (2.9)
	%	92%	84%	96%
HCDG	**Mean**	69.5	24	25.5
	Median	69.5	24	25.5
	Min - Max (SD)	40 - 96 (18.79)	12 - 32 (6)	8 - 32 (7)
	%	62%	50%	58%
ADHDG	**Mean**	46	13.5	20.5
	Median	46	13.5	20.5
	Min - Max (SD)	39 - 68 (13.3)	4 - 28 (6.6)	14 - 36 (7.3)
	%	39%	28%	47%

Caption: CG = control group; HCDG = human communication disorder group; ADHDG = attention-deficit/hyperactivity disorder group; AP = Auditory Processing; ATT = Attention; LGG = Language; Min = minimum; Max = maximum; SD = standard deviation; % = percentage

the comparison of the total and domain scores between the three study groups, selecting for the pilot study a small sample of schoolchildren who represented the questionnaire's target population, distributed homogeneously in terms of sex and age.

The pilot study found that the CG had the highest mean total score on the questionnaire, compared to the two study groups. This finding is consistent with other studies in the literature with the APDQ, which show that the group of typically developing children has the best scores on the questionnaire[16,18,19].

CG participants had medians of 35, 42, and 103.5 points in the attention, language, and auditory processing domains, respectively. These results are similar to those found in a national study that used the previous 52-item questionnaire[18]. In the current study, normal-hearing children and adolescents had medians of 29, 43, and 114 points. Overall, the questionnaire results were similar to the previous Brazilian study[18].

A study applied the Persian APDQ version to children with and without learning difficulties. The results reported by the authors indicate high percentages in all domains for the CG, compared to the study group[34]. The same is observed in the results of the questionnaire author, as the CG's percentages in the three domains exceed those of the other groups, suggesting that individuals with comorbidities have lower auditory processing skills[16].

The CG had a lower total score SD, indicating more homogeneous scores, whereas the HCDG and ADHDG had much higher SDs. This difference can be attributed to the greater heterogeneity in these groups since children with language or attention difficulties can present significantly varying characteristics and symptoms. This means a greater diversity of impairment levels in the HCDG and ADHDG, which impacted their scores. However, this variability can be considered a bias in the study, since heterogeneity makes it difficult to identify consistent patterns, especially in a small sample such as that of this study.

The domains had the same configuration – i.e., the CG had the highest mean, followed by the HCDG and, lastly, the ADHDG. The attention domain had the worst performance in the three groups, a finding similar to the first Brazilian study and the international study mentioned[16,18]. The domain with the best score was language, a finding also found in the study that originated the questionnaire[16].

When analyzing the cutoff for risk of changes, it was found that the ADHDG and HCDG groups had percentages indicative of risk in the domains of language, auditory processing, and attention. The original questionnaire study[16] with 22 individuals with ADHD found 52% for auditory processing, 26% for attention, and 64% for language. In the group of children with CAPD, the percentages were 38%, 59%, and 66%, respectively. Although the results differ from the current research, they demonstrate that the percentages remain below the established cutoffs.

The ADHDG and HCDG participants in this study had percentages of risk for changes in the language, attention, and auditory processing domains. This was expected, considering that both groups comprised individuals who already had issues in these areas, reflecting their difficulties in activities that demand efficient auditory processing, sustained attention, and linguistic skills. Moreover, these diagnoses interact significantly since it is common for difficulties in one of these domains to influence the others, making their diagnosis more complex[35].

The parents/guardians' education level can significantly influence how they answer questionnaire items. Those with a higher level of education tend to have a more in-depth understanding of the symptoms and criteria assessed, which probably makes it easier to interpret the questions and more accurately describe the experiences and behaviors of the individuals being assessed. This ability to interpret can lead them to answer the questionnaire more carefully and accurately, identifying signs and difficulties better. On the other hand, parents/guardians with a lower level of education may face challenges in understanding the questions, possibly resulting in less accurate responses or an erroneous interpretation of the symptoms. Therefore, questionnaire result analyses must consider the parents/guardians' education level, as it can directly impact the quality and validity of the information[36].

Age can also play an important role in APDQ responses. Younger children tend to have greater challenges in areas such as attention and language due to their stage of development, resulting in lower percentages in these areas. Older children, on the other hand, because they are more mature and experienced, may perform better in certain areas, even when they have problems. This difference in performance between age groups highlights the importance of considering their ages when interpreting the questionnaire results, ensuring that comparisons are fair and that risk percentages are contextualized according to age group[35].

The three groups' APDQ raw scores in the pilot study were similar to those found in the literature[16,18,19]. However, this study's analyses did not include the primary risks (outcomes) because, as it was a pilot study with a small sample, these analyses would not be robust enough and would result in excessively segmented outcomes, compromising the validity of the results and making it difficult to identify consistent patterns.

As this is a relatively new instrument, published in 2018 and modified in 2021, no other studies with the same version of the questionnaire were found. Therefore, the data were compared with other studies that used the 52-item questionnaire, which may present variations in the analyses.

Questionnaire research is a constantly evolving process that requires larger and more diverse samples, covering different populations and contexts. Therefore, the study should continue with the translated and adapted version of the APDQ for Brazilian Portuguese, selecting samples with a significantly larger number of participants and robust statistical analyses that can generalize its results.

CONCLUSION

The standardized translation method used in this study proved to be effective in ensuring the cultural equivalence of the APDQ in Brazilian Portuguese.

The study provided the Brazilian Portuguese version of the 50-item APDQ, which will assist professionals in the field in the early identification and differentiation of children and adolescents at risk of developing CAPD.

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Annex 1. Auditory Processing Domains Questionnaire

PERSONAL INFORMATION

Name of the child _____

1. Today's date _____ 2. Child's DOB _____

3. Sex _____ 4. Grade in school _____

5. Person answering the questionnaire:

(a) mother _____ (b) father _____ (c) other relative (specify) _____ (d) teacher _____ (e) other (specify) _____

6. Is the language used at the child's school the child's native language used at home? ( ) Yes ( ) No

7. Father's completed years of schooling _____

8. Mother's completed years of schooling _____

9. Please indicate the degree of your concern about the student's listening skills:

(a) none _____ (b) mild _____ (c) moderate _____ (d) high _____

10. Please indicate the child's sensitivity/stress reaction to loud sounds and noisy environments.:

(a) none _____ (b) mild _____ (c) moderate _____ (d) high _____

11. Please indicate the child's difficulty in localizing sounds (knowing whether a sound is coming from the right or left, in front or behind, near or far, quickly or slowly; knowing who is speaking in a group or where a dog's barking is coming from):

(a) none _____ (b) mild _____ (c) moderate _____ (d) high _____

12. Please indicate when one or more of the following conditions or services occurred for this child:

a.____ Special education

b.____ Learning difficulties

c.____ Specific language disorder

d.____ Dyslexia (reading difficulty)

e.____ History of delayed speech/language acquisition or speech-language-hearing therapy

f._____ Permanent hearing loss:

(1) mild _____ (2) moderate _____ (3) severe _____

(a) unilateral _____ (b) uses hearing aid _____ (c) cochlear implant _____

g.____ The child learned Portuguese as a second language after 5 years old

h.____ Attention-deficit disorder (ADHD)

i._____ Chronic or recurrent otitis media or surgery (circle and explain) _____

j._____ Jaundice at birth:

(a) mild _____ (b) moderate _____ (c) severe _____ (d) blood transfusion _____

k.____ (Central) auditory processing disorder

l._____ Autism/Asperger syndrome

m.____ Developmental delay/intellectual disability

Instructions:

This questionnaire reviews the student's everyday listening skills. Language, attention, and listening skills are important.

Please rate the student's performance on each of the items below based on your observations. Remember what is expected of them at their age. The term "noisy background" refers to background noise from TV, voices, music, machinery, etc. Light to moderate noise can interfere with the ability to hear words correctly. "Hearing correctly" means hearing statements correctly without needing to be repeated.

Check:

Column 1 if the skill is observed regularly (over 75%).

Column 2 if the skill is observed often (over 50%).

Column 3 if the skill is observed sometimes (under 50%).

Column 4 if the skill is observed rarely (under 25%).

Assess all items – write NA if you cannot assess the item.

	Almost always (over 75%)	Frequently (over 50%)	Sometimes (under 50%)	Rarely (under 25%)
1. The child pays close attention when talking to just one person.				
2. The child pays close attention when listening in quiet environments in the presence of other people (meals, meetings, classes, etc.).				
3. The child pays close attention when listening in noisy environments in the presence of other people (meals, meetings, classes, etc.).				
4. The child hears your words correctly (without repetitions) when paying attention in quiet environments.				
5. The child hears your words correctly (without repetitions) when paying attention in noisy environments (where other people may be talking at the same time).				
6. The child takes their time to listen carefully and correctly to important information.				
7. The child understands instructions when paying attention in quiet environments.				
8. The child understands instructions when paying attention in noisy environments.				
9. The child understands others when in echoey places – gyms, cafeterias, and auditoriums with loudspeakers.				
10. The child understands your conversation while others are talking nearby (e.g., at parties and meals).				
11. The child can hear you correctly while doing something else (e.g., video games or small household chores).				
12. The child can hear correctly WITHOUT visual clues (without seeing the speaker's face or gestures, without having pictures or illustrations).				
13. The child concentrates well when doing activities that do not require listening (studying, other household chores).				
14. The child concentrates well when listening to stories and presentations.				
15. The child understands written instructions (as expected for age).				
16. The child gets tired easily when studying (yawns or plays with hands).				
17. The child gets tired easily when listening (yawns or plays with hands).				
18. The child can explain things reasonably well during conversations.				
19. The child focuses on important tasks even if they are not fun or interesting.				
20. The child hears words well when the speaker has their back turned (or when the speaker is behind the child).				
21. The child says "what?" or needs repetition when talking with interest in quiet environments.				
22. The child says "what?" or needs repetition when talking with interest in noisy environments.				
23. The child pays attention to details – avoids careless mistakes when doing schoolwork.				
24. The child understands and uses longer sentences (as expected for age).				
25. The child understands and responds promptly to questions in quiet environments (when attentive).				
26. The child understands and responds promptly to questions in noisy environments (when attentive).				
27. The child follows oral instructions, with steps or sequences (as expected for age).				
28. The child organizes tasks and activities to complete them in time.				
29. The child understands and uses common age-appropriate slang.				
30. The child misses or forgets to do things (is absent-minded).				
31. The child understands people who speak less clearly (fast or slurred, with accents, etc.).				
32. The child understands speakers with soft or high-pitched voices (shy people – children's voices and some female voices).				
33. The child hears the phone well without needing to have information repeated (including names and numbers).				
34. The child can hear people about two meters away correctly (when they are standing or sitting together).				
35. The child hears words incorrectly or confuses words that sound similar (like "*faca*" and "*vaca*", "*sessenta*" and "*setenta*").				
36. The child remembers and uses new words correctly (as expected for age).				

Caption: DOB = date of birth

	Almost always (over 75%)	Frequently (over 50%)	Sometimes (under 50%)	Rarely (under 25%)
37. The child can pronounce new words correctly after hearing them a few times (including names of people and places).				
38. The child can recognize the sounds of letters and establish the correspondence between letters and writing to help them read and write the word correctly (as expected for age).				
39. The child reads at a good speed (as expected for age).				
40. The child controls impulses and agitation to avoid dangerous and upsetting situations.				
41. The child remembers details of verbal instructions or requests (shortly afterward, without the need for repetition).				
42. The child learns things well by listening – without needing further explanations or visual support.				
43. The child follows rhythmic and intonation patterns by clapping, drumming, or humming with others.				
44. The child varies their voice to add emphasis, speak clearly, and sound more pleasant.				
45. The child perceives "how" things were said when interpreting comments and following instructions (notices different tones of voice, emphasis on key words, etc.).				
46. The child understands what is said without needing simpler words.				
47. The child hears well without having to turn things up louder (including voices and warning signals).				
48. The child can speak easily and fluently for age (without forgetting words or using too many pauses).				
49. The child understands conversations and instructions without having to control "extra" noises (e.g., turning off the TV, closing windows, changing seats).				
50. The child understands people without needing them to speak more slowly or more clearly.				

Caption: DOB = date of birth