

# POLISH ADAPTATION OF THE CHILDREN'S HOME INVENTORY FOR LISTENING DIFFICULTIES AND ITS USEFULNESS IN SCREENING FOR AUDITORY PROCESSING DISORDER

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## Contributions:

A Study design/planning  
B Data collection/entry  
C Data analysis/statistics  
D Data interpretation  
E Preparation of manuscript  
F Literature analysis/search  
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## Abstract

**Background:** Auditory Processing Disorder (APD) affects 2–7% of school-age children. Diagnosis of APD is challenging and there is a need for an adequate, valid, and reliable tool for its screening and diagnosis. The aim of our work was to adapt the Children's Home Inventory for Listening Difficulties (CHILD; version for parents) into Polish, evaluate its psychometric properties, and assess its potential usefulness as a screening tool.

**Material and methods:** There were 239 parents who participated in the study. Their children were 113 girls and 126 boys aged 5–12 years old (average 8.6 years). Two psychoacoustic tests were conducted on the children: the Frequency Pattern Test (FPT) and the Duration Pattern Test (DPT). The parents filled in two questionnaires: the Children's Home Inventory for Listening Difficulties (CHILD) and the Scale of Auditory Behaviors (SAB).

**Results:** Reliability of measurements was good, and Cronbach's alpha coefficient (0.93) showed a high internal consistency for CHILD. Correlation between the CHILD and SAB scores was moderate ( $r = 0.66$ ), but correlations with the psychoacoustic tests were low ( $r = 0.18$  for FPT and  $0.29$  for DPT). CHILD did not show any difference between children who had normal and abnormal results in the psychoacoustic tests. A ceiling effect was evident for all 15 items of CHILD, with parent scores being generally high (average 6.93) on a scale from 1 to 8 points.

**Conclusions:** In screening for Auditory Processing Disorder, the CHILD questionnaire (version for parents) can be used to assess children's communication difficulties and listening and understanding skills in various home situations. However, for application to Polish children generally it needs to be verified in other study samples.

**Key words:** screening • questionnaires • Auditory Processing Disorder

## ADAPTACJA KWESTIONARIUSZA TRUDNOŚCI SŁUCHOWYCH DZIECKA DO JĘZYKA POLSKIEGO I JEGO UŻYTECZNOŚĆ W BADANIACH PRZESIEWOWYCH ZABURZEŃ PRZETWARZANIA SŁUCHOWEGO

### Streszczenie

**Wprowadzenie:** Zaburzenia przetwarzania słuchowego (Auditory Processing Disorder, APD) dotyczą 2–7% dzieci w wieku szkolnym. Zdiagnozowanie APD jest trudne, brakuje odpowiedniego obowiązującego i rzetelnego narzędzia do badań przesiewowych i diagnostycznych. Celem tej pracy była adaptacja Kwestionariusza Trudności Słuchowych Dziecka (Children's Home Inventory for Listening Difficulties, CHILD; wersja dla rodziców) do języka polskiego, ocena jego własności psychometrycznych i potencjalnej użyteczności jako narzędzia do badań przesiewowych.

**Materiał i metody:** W badaniu wzięło udział 239 rodziców. Ich dzieci było: dziewczynek – 113 i chłopców – 126, w wieku 5–12 lat (średnia 8,6 roku). Dzieci przeszły dwa badania psychoakustyczne: Frequency Pattern Test (FPT) i Duration Pattern Test (DPT). Rodzice wypełnili dwa kwestionariusze: Kwestionariusz Trudności Słuchowych Dziecka (CHILD) i Skalę Zachowań Słuchowych (Scale of Auditory Behaviors, SAB).

**Wyniki:** Rzetelność pomiarów była dobra, a współczynnik alfa Cronbacha (0.93) wskazuje na wysoką wewnętrzną spójność testu CHILD. Korelacja pomiędzy wynikami CHILD i SAB była umiarkowana ( $r = 0.66$ ), ale poziom korelacji z testami psychoakustycznymi był niski ( $r = 0.18$  dla FPT i  $0.29$  dla DPT). Test CHILD nie wskazał żadnych różnic pomiędzy dziećmi, które uzyskały prawidłowe i nieprawidłowe wyniki w testach psychoakustycznych. Efekt sufitu był wyraźny dla wszystkich 15 punktów CHILD: wyniki rodziców były ogólnie wysokie (średnio 6.93) w skali wyników od 1 do 8 punktów.

**Wnioski:** W badaniach przesiewowych pod kątem zaburzeń przetwarzania słuchowego kwestionariusz CHILD (w wersji dla rodziców) może być stosowany do oceny trudności komunikacyjnych i kompetencji dziecka w zakresie słuchania i rozumienia w różnych sytuacjach domowych. Wersja kwestionariusza dla polskich dzieci musi zostać zweryfikowana na innych próbach badawczych.

**Słowa kluczowe:** badania przesiewowe • kwestionariusze • zaburzenia przetwarzania słuchowego

## Introduction

According to the American Speech-Language-Hearing Association, the term ‘Auditory Processing Disorders’ (APD) refers to difficulties in the perception of auditory information by the central nervous system. It may exhibit as difficulties relating to sound localization and lateralization, auditory discrimination, adequate understanding of acoustic signals in noise, auditory pattern recognition, and temporal aspects such as: integration, ordering, discrimination, and masking [1]. Similarly, the British Society of Audiology defines APD as a disorder characterized by poor perception of speech and non-speech sounds related to deficiencies in the central auditory nervous system [2]. In day-to-day situations, parents and teachers may see difficulties in children comprehending long instructions, understanding speech, mistaking similar-sounding words, and concentration and attention. Teachers often report learning problems in areas such as: orthography, mathematics, reading and writing, and difficulties in learning foreign languages [2–4].

The prevalence of APD in school-age children ranges between 2 and 7% [5,6]. However research by Elsisy [7] showed that following a protocol that included screening and using standardized questionnaires, the number of suspected APD cases could be reduced by more than a half. This would reduce health service costs, save time, and avoid stress to children and their parents.

According to Bellis [8], the main aim of screening by questionnaire is to identify pupils who are at risk of APD. Using a screening tool allows one to obtain information about functional auditory abilities, and it can gauge the need to undertake future complex diagnosis involving a multidisciplinary team of laryngologist, speech therapist, psychologist, and audiologist [1,7]. In Polish schools, the first assessment of any APD symptoms usually involves, as part of a routine hearing screening program, a team of psychologist, special educator, and speech therapist. Specialists use a diverse battery of standardized psychological tests (the Wechsler Intelligence Scale for Children; the Stanford-Binet test; and the Intelligence and Development Scale). In this way they can assess difficulties that may be related to other deficits such as: attention, speech-language impairment, dyslexia, and lack of development of cognitive processes [9,10].

Because an increasing number of hearing screening programs are being conducted in schools [11,12], a screening questionnaire assessing symptoms of APD could be incorporated into routine procedures and provide additional information about a pupil. A questionnaire can allow a pupil’s difficulties as observed by a teacher to be compared with the perspective of the parents [13]. Geffner et al. [14] listed several questionnaires and checklists that could be used for screening: the Scale of Auditory Behaviors (SAB) [15,13], the Children’s Home Inventory for Listening Difficulties (CHILD) [16], the Children’s Auditory Performance

Scale (CHAPS) [17], the Fisher Auditory Processing Checklist [18], The Listening Inventory (TLI) [19], and the Listening Inventory for Education – Revised (LIFE-R) [20]. These are designed to provide qualitative data about a child’s functioning in a variety of acoustic situations. According to the British Society of Audiology [2], these questionnaires provide some useful information, although not all of them have been validated. The BSA flags an urgent need for validated and standardized APD screening questionnaires.

In Poland, the Scale of Auditory Behaviors has been adapted by Skarżyński et al. [13] for evaluation of APD symptoms. There is a need for other questionnaires that can provide information about APD in a domestic environment. From among the available questionnaires, the ‘‘Children’s Home Inventory for Listening Difficulties (CHILD) – version for parents’’ appears adequate: it is a simple and easy-to-fill-in tool based on parents’ observations. The American Academy of Audiology suggests using it as a screening tool for APD [15]. Jordan et al. [21] surveyed a number of studies in which CHILD was used and concluded that it was an adequate tool for evaluating the child’s perception of sounds. However, until now, no Polish adaptation has been available.

The primary aim of this study was to adapt to Polish conditions the Children’s Home Inventory for Listening Difficulties (CHILD) version for parents and evaluate its psychometric properties. A secondary aim was to verify its usefulness as a screening tool.

## Material and methods

The ‘‘Children’s Home Inventory for Listening Difficulties (CHILD) version for parents’’ was created by Anderson & Smaldino [16]. The American Academy of Audiology suggests this questionnaire can be used as a tool for screening for APD [15]. The authors of the questionnaire indicate that it may be used to assess listening behavior, level of current ability, monitor progress, evaluate therapy, and measure benefits from using a hearing device [22].

The questionnaire contains 15 items on 5 subscales: Quiet (4 items), Noise (4 items), Distance (3 items), Social (3 items), and Media (1 item). Items describe daily home situations involving understanding in quiet and in noise, localization of different sounds, and communication skills. It is targeted at assessing hearing function in children aged 3 to 12. The CHILD questionnaire is filled in by family members who know the child’s habits well, and allows parents and teachers to gauge the child’s hearing ability. It is based on an 8-point scale, called an ‘‘Understand-O-Meter’’, in which parents are required to give a numerical answer from 1 to 8: 8 means *Great, hear every word, understand everything*; 7, *Good, hear it all, miss part of an occasional word, still understand everything*; 6, *Pretty good, hear almost all the words and usually understand everything*; 5, *Okay but not easy, hear almost all the words, sometimes misunderstand what was said*; 4, *It takes*

*work but usually can get it, hear most of the words, understand more than half of what was said; 3, Sometimes get it, sometimes don't, hear words but understand less than half of what was said; 2, Tough going, sometimes don't know right away that someone is talking, miss most of message; 1, Huh? Don't know that someone is talking, miss all of message.* The total score ranges from 15 to 120 points, which is then divided by 15, giving an average rating for the degree of hearing difficulties [16,22].

### Translation and cultural adaptation of the CHILD version for parents

Adaptation of the CHILD was based on the guidelines of Beaton et al. [23]. First, permission from the authors was obtained to adapt the questionnaire. The second stage involved translating the original items of the CHILD questionnaire using a bilingual translator using the process of translation and back-translation. Then a group of specialists in the areas of laryngology, audiology, speech therapy, developmental psychology, and English translation assessed the translations. Both versions were compared and discussed and the best version chosen.

### Study design

Participants were recruited during a hearing screening program in two preliminary schools, one in a town and one in a rural area. There were 239 parents of 113 girls and 126 boys. Their children were aged 5 to 12 years old ( $M = 8.58$ ;  $SD = 1.64$ ) with normal intellectual development. Learning difficulties (lower academic records) were observed in 4 children. Data about speech development and detailed hearing status (audiogram) were not collected. Teachers did not observe any symptoms in the children such as: difficulties with understanding speech due to hearing problems. None of the children used a hearing prosthesis.

The children's parents were informed of the test procedures and signed a consent form for their children to participate. Appointments were organized with the parents so as to increase their awareness of the effect of hearing disorders on daily school activities, peer group interactions, school marks, learning potential, and psychological well-being.

Parents filled in two questionnaires: the Children's Home Inventory for Listening Difficulties (CHILD) and the Scale of Auditory Behaviors (SAB). In addition, we conducted two psychoacoustic behavioral tests: the Frequency Pattern Test (FPT) and the Duration Pattern Test (DPT). FPT was performed in order to assess the child's ability to distinguish tone sequences of different frequency [24]. The test includes 40 sequences of sounds with every sequence consisting of three tones: two of the same frequency and another of different frequency. The child's task is to identify whether each tone is low or high (880 Hz or 1122 Hz). For example, if a sequence of high tone, high tone, and low tone is presented, the correct answer is high-high-low. This task is done randomly 30 times, and the score is the percentage of correct answers [25,26]. DPT evaluates the ability to distinguish tone sequences of different length. The test uses 30 random sequences of three 1000 Hz tones of different length: two of the same length and another

of different length (a short tone of 250 ms and a long one of 500 ms). Thus, if a short tone, short tone, and long tone is presented, the correct answer is short-short-long. The task is presented 30 times in random order and the score is the percentage of correct answers [25,26].

Reference values of FPT and DPT for Polish children aged 7 to 10 years have been proposed by Włodarczyk et al. [26] and were used in our analyses. Testing was conducted in quiet using the Sense Examination Platform. The platform uses headphones (Sennheiser HDA200) to acoustically isolate the ear from background noise.

### Characteristics of the Scale of Auditory Behaviors (SAB)

The Polish version of the SAB adapted by Skarzynski et al. [13] was used in this study. The questionnaire comprises 12 items related to daily situations where difficulties in understanding may arise (hearing in noise, fast or quiet speech, and complex instructions) as well as concentration and attention. Parents or teachers give answers on a 5-point scale ranging from "very often" (1 point) to "never" (5 points). The overall score (from 12 to 60) is calculated by summing up the points. The higher the score, the lower the difficulty. The Polish version of SAB demonstrates high internal consistency (Cronbach's  $\alpha = 0.93$ ), confirmed by inter-item correlations. The intraclass correlation (ICC), used to determine reproducibility, was 0.95 [13,27,28].

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki and the study protocol was approved by the Institutional Review Board at the Institute of Physiology and Pathology of Hearing (KB.IFPS: 32/2018).

### Statistical and psychometric analysis

Descriptive statistics ( $M$ , mean;  $Me$ , median,  $SD$ ; standard deviation; skewness; kurtosis) were calculated from the CHILD scores. A Kolmogorov-Smirnov test was used to check the normality assumption.

Reliability was assessed as internal consistency and test-retest reliability. Internal consistency was measured by Cronbach's alpha coefficient and by correlations between the CHILD subscales. According to the criterion proposed by Nunnally & Bernstein [29], internal consistency was considered good when Cronbach's alpha was above 0.70. test-retest reliability was assessed using the intraclass correlation coefficient (ICC) with a positive rating being above 0.70 [30].

Validity was evaluated in two ways [31]. A rho-Spearman correlation was used to assess relationships between CHILD scores, SAB scores, and the results of psychoacoustic behavioral tests. It was hypothesized that the higher the SAB score, the higher would be the CHILD score; similarly, the higher the results of the psychoacoustic tests, so too would be the CHILD score. Discriminative validity was evaluated by comparing CHILD scores between sex and age groups. We assumed that older children would score higher than younger children.

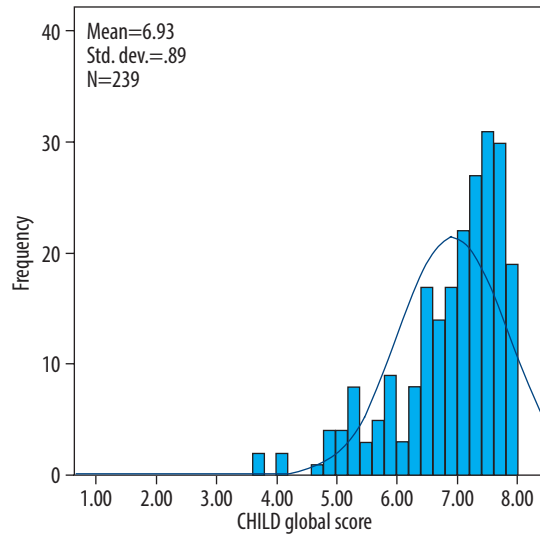
Responsiveness was assessed in terms of the number of items exhibiting floor and ceiling effects. A floor effect was found if more than 15% of respondents achieved the lowest possible score; a ceiling effect was found if more than 15% of respondents achieved the highest possible score [30].

All statistical analyses were performed in SPSS (version 24). The statistical significance threshold was set at  $p < 0.05$ .

**Results**

**Basic statistics for CHILD**

The distribution of CHILD global scores was assessed in terms of normality. Skewness was  $-1.21$ , kurtosis was  $1.28$ . The distribution was negatively skewed, which means that there were more high scores on the right side of the histogram. The distribution was leptokurtic, being more peaked than normal. A Kolmogorov-Smirnov test was statistically significant ( $K-S=0.13$ ;  $p < 0.001$ ), meaning that data did not conform to a normal distribution. **Figure 1** shows the distribution of CHILD global stores.



**Figure 1.** Distribution of CHILD global scores. The curve is a fit to a normal distribution

**Table 1.** Descriptive statistics for CHILD scores ( $n = 239$ )

	Range	<i>M</i>	<i>Me</i>	<i>SD</i>	Cronbach's $\alpha$
Quiet	3.75–8.00	7.31	7.50	0.80	0.80
Noise	2.50–8.00	6.59	7.00	1.09	0.82
Distance	3.00–8.00	6.93	7.33	1.06	0.83
Social	3.67–8.00	6.98	7.33	0.90	0.79
Media	2.00–8.00	6.96	7.00	1.17	–
Total	3.67–8.00	6.93	7.20	0.89	0.93

**Table 2.** Frequency distribution of responses for each item of CHILD

	1	2	3	4	5	6	7	8
Item 1	–	0.4	0.8	–	3.8	4.6	29.3	61.1
Item 2	–	–	–	1.3	0.8	12.1	31.8	54.0
Item 3	0.4	1.3	3.3	1.7	5.9	18.0	34.3	35.1
Item 4	–	0.4	1.3	2.9	6.3	14.6	35.6	38.9
Item 5	–	0.4	1.3	0.8	3.8	14.2	28.5	51.0
Item 6	2.9	4.6	4.2	4.6	12.6	20.9	31.4	18.8
Item 7	–	2.1	3.8	2.1	7.5	17.6	32.2	34.7
Item 8	0.8	8.4	1.7	5.4	10.0	13.8	26.8	33.1
Item 9	–	0.4	2.1	2.1	6.3	19.7	45.4	23.9
Item 10	–	0.8	0.8	0.8	5.5	16.8	33.6	41.6
Item 11	–	0.4	0.4	2.1	6.3	14.3	39.9	36.6
Item 12	–	0.8	3.4	2.1	7.2	24.1	35.9	26.6
Item 13	–	–	2.5	1.7	4.2	10.9	34.0	46.6
Item 14	–	0.4	0.8	0.8	5.0	21.4	34.0	37.4
Item 15	–	0.4	0.4	0.4	0.8	4.6	17.2	76.1

**Table 3.** Correlations between CHILD subscales

	Noise	Distance	Social	Media	Total
Quiet	0.74**	0.74**	0.76**	0.59**	0.87**
Noise		0.87**	0.86**	0.51**	0.94**
Distance			0.85**	0.53**	0.93**
Social				0.54**	0.91**
Media					0.65**

\*\*  $p < 0.01$ **Table 4.** Correlations between CHILD scores and other measures

	SAB	FPT	DPT
Quiet	0.51**	0.18**	0.24**
Noise	0.65**	0.16*	0.28**
Distance	0.62**	0.14*	0.24**
Social	0.59**	0.13	0.25**
Media	0.46**	0.15*	0.24**
Total	0.66**	0.18**	0.29**

\*\*  $p < 0.01$ , \*  $p < 0.05$ **Table 5.** Comparison of CHILD scores between girls and boys

	Girls		Boys		<i>U</i>	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Quiet	7.45	0.63	7.17	0.91	5864.5	0.017
Noise	6.79	0.96	6.41	1.18	5780.5	0.012
Distance	7.12	0.91	6.76	1.15	5812.5	0.013
Social	7.18	0.75	6.80	0.99	5582.0	0.004
Media	7.12	1.04	6.81	0.75	6179.0	0.062
Total	7.07	0.75	6.77	0.98	5802.5	0.014

Descriptive statistics and Cronbach's alpha are summarized in **Table 1**. Mean scores for all subscales were at the higher end of the scoring range. Medians were higher than mean scores, which indicates that scoring was rather high. Dispersion was small, and SDs did not exceed 20% of mean scores. Cronbach's alpha coefficients ranged from 0.79 to 0.83 for subscales and was 0.93 for CHILD global score.

The frequency distribution of responses to each CHILD item are displayed in **Table 2**. All 15 items met a criterion for acceptable floor effects. However, all 15 items showed ceiling effects, with 18.8% to 76.1% of participants scoring 8 (the highest response option).

The correlations between CHILD subscales are summarized in **Table 3**. Correlations ranged from 0.51 to 0.94. They showed moderate to strong relationship between subscales.

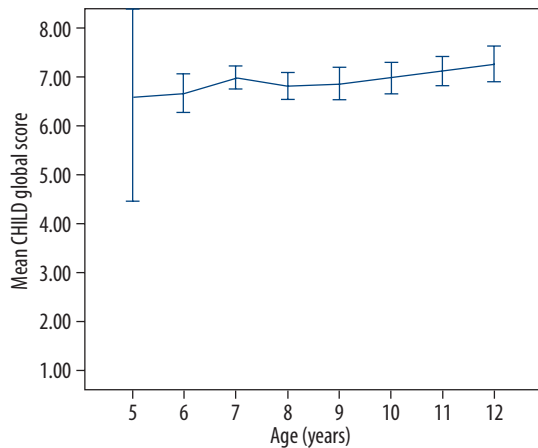
### CHILD and other measures

Descriptive statistics for the SAB questionnaire and psychoacoustic tests were calculated. Mean score on

SAB was 46.08 ( $SD = 9.65$ ), mean score on FPT was 49.68 ( $SD = 23.78$ ), and mean score on DPT was 62.91 ( $SD = 25.59$ ).

Correlations between CHILD scores and other measures are displayed in **Table 4**. Correlations between CHILD and SAB ranged from 0.51 to 0.65, indicating moderate relationship between both measures. Correlations between CHILD and psychoacoustic tests were low, ranging from 0.13 to 0.29.

CHILD global score was compared in two groups of children: those with normal results on psychoacoustic tests (both FPT and DPT), and those with abnormal results on at least one psychoacoustic test (FPT or DPT). Children with normal results on psychoacoustic tests ( $M = 6.99$ ;  $SD = 0.87$ ) scored slightly higher on CHILD than children with abnormal results in psychoacoustic tests ( $M = 6.61$ ;  $SD = 1.15$ ), but the difference between the two groups was not statistically significant ( $U = 2072$ ;  $p = 0.100$ ).



**Figure 2.** Mean scores by age for CHILD global score

### Sex and age-related differences in CHILD

There were statistically significant differences in CHILD scores between girls and boys (Table 5). Girls scored higher than boys on almost all subscales (except Media) and in Total.

A Kruskal-Wallis test was used to compare scores obtained on CHILD (global score) by children of different ages. There was a slight trend for age groups: 5-year-old children scored 6.56 on average, 12-year-old children scored 7.26 on average, but the differences between the age groups were not statistically significant ( $H=20.72$ ;  $p=0.338$ ). Mean scores for children of different ages are shown in Figure 2.

### Test-retest reliability

Test-retest reliability was assessed in 16 subjects. There were no statistical differences between two administrations (test and retest) in any subscale. The mean global score for the first test was  $M=6.68$  ( $SD=0.86$ ); in retest it was similar ( $M=6.54$ ,  $SD=0.88$ ). ICC for global score was 0.83, and for the subscales 0.60 (Quiet), 0.77 (Noise), 0.79 (Distance), 0.94 (Social), and 0.65 (Media).

### Discussion

The aim of this study was to adapt the CHILD questionnaire for parents into Polish and evaluate its psychometric properties. If CHILD proved to be a valid and reliable tool, it could be used in auditory processing screening and identify children at risk of CAPD.

So far, to the author's best knowledge, only a Korean adaptation of the CHILD questionnaire has been done [32]. That study was conducted on 55 parents of children aged 3 to 12 years old who had a diagnosis of hearing loss and were users of cochlear implants. The authors concluded that CHILD was a reliable and valid tool and could be used in various home situations for assessing listening and communication difficulties in children with hearing loss.

Our findings show that, in a study group consisting of 239 parents of children aged 5 to 12 years old, the reliability of

CHILD (as assessed by internal consistency and test-retest reliability) was good. An indicator of internal consistency, Cronbach's alpha, was 0.93 for the overall scale and ranged from 0.79 to 0.83 for the subscales, again indicating high reliability. In a similar way, Choi et al. [32] found the internal consistency of CHILD was high, with a Cronbach's alpha of 0.96 for the overall scale.

Test-retest reliability measured with ICC ranged from 0.60 to 0.94 for the subscales and was 0.83 for the global score. According to Terwee et al. [30], a positive rating for ICC should be above 0.70. Based on this criterion, a high test-retest reliability was found for three subscales (Noise, Distance, and Social) and for overall score.

Other results obtained in our study were not so promising. The minimum score on CHILD is 1 point, the maximum is 8 points, so in this context the average of 6.93 in the study sample seems high. The distribution of CHILD global scores (Figure 1) clearly shows that the majority of parents assessed their children's hearing function as high or very high, mostly 6, 7, or 8 points. The parents' scores were quite consistent, as evidenced by small dispersion ( $SD=0.89$ ).

A similar conclusion derives from the number of items exhibiting floor and ceiling effects. A ceiling effect was observed for all 15 items. It was particularly evident for item 15, where 76.1% of the parents chose the highest possible score (8 points), and for item 1, where 61.1% of parents scored 8 points. Both these items concern the child's ability to listen and understand in quiet and in face-to-face communication, tasks which are easy for children with normal hearing.

Our study did not show convincing evidence for CHILD's validity and call into question whether this tool is satisfactory for auditory processing screening. Correlations between CHILD and SAB were positive but not high, only moderate. Stronger correlations might be expected between these two self-reported measures. But even more important was the weak relationship between CHILD and the psychoacoustic tests. For global score the correlation was only 0.18 (for FPT) and 0.29 (for DPT). Psychoacoustic tests are used as a standard in diagnosing APD, so their results and the results of any newly introduced measure should be strongly linked. In our study we did not find any strong correlation between CHILD and psychoacoustic tests, nor any expected difference between the two groups of children, those with normal results and those with abnormal results in psychoacoustic tests. Therefore, our results do not support the criterion validity of CHILD.

We did find differences between girls and boys in the CHILD results. Girls scored significantly higher than boys. This is not congruent with the conclusion reached by Szkielkowska et al. [33], who found that Polish girls and boys had similar levels of auditory function and scored equally well in psychoacoustic tests (FPT and DPT).

Our findings showed differences between age groups. Older children scored significantly higher than younger children and in the youngest children (age 5), the dispersion of scores was very large (Figure 2). These results are

in line with other researchers who have pointed out that central auditory processing depends on age and development [26,33–36].

In this work, the CHILd Parents questionnaire has been assessed for its suitability for auditory processing screening. Other research has used this tool to assess listening behavior, hearing ability, monitoring progress, outcomes of therapy, and benefits from using devices such as hearing aids or cochlear implants [37,38]. In a study by Condie et al. [39], the CHILd questionnaire was used to assess the benefits from analog versus digital hearing aids. The study group was 10 children aged 5 to 14 years old with moderate to severe bilateral hearing loss, and the questionnaire was used to evaluate subjective changes. It showed that the average CHILd score increased from 4.5 to 5.9 points. Despite bilateral hearing loss, parents assessed that children had no hearing difficulties when using digital hearing aids. In this study, objective measurements showed that children obtained better results in speech understanding tests in quiet as well as in noisy acoustic environments. This was similar to the results of the questionnaire. If speech understanding improved, the CHILd score also increased.

Briggs et al. [40] examined the benefit of conventional hearing aids (Oticon Epoq XW) in 8 children (ages 7–12) with mild to moderately severe unilateral hearing loss. The parents assessed their children's listening and understanding with CHILd. The average score increased significantly from 5.38 before amplification to 6.56 points after 3–4 months of hearing aid use. The authors concluded that CHILd can show up clinically important changes and measure the benefit of hearing aids in children with unilateral hearing loss.

In our study we found that the parents scored their children's listening and understanding skills very highly, so we assume that the tasks given in the items are too easy for children with normal hearing. In our opinion, CHILd is not sensitive enough to detect potential signs of APD. A second major argument against using CHILd in APD screening is its weak correlations with psychoacoustic tests, which indicate that the two approaches are not consistent enough.

Musiek & Chermak [15] expressed the view that CHILd may serve as a broad screen for auditory processing

deficits. Our research does not confirm this opinion. We suggest the questionnaire could be used to assess communication difficulties and listening and understanding skills in various home situations for children who have hearing losses; however, for Polish children generally it needs to be verified in other study samples.

### Limitations of the study

Central auditory processing depends on many factors: age, speech and intellectual development (cognitive processes), and learning difficulties. The data should be adequately fitted in this study. Further work should assess variables such as: cognitive processes (using structured tools e.g. SB-5, the Stanford-Binet intelligence scale), speech development, and level of hearing (pure tone audiometry). The important part of further research is to establish whether the presented symptoms in children are actually APD or some other specific disorder.

### Conclusions

In screening for Auditory Processing Disorder, the CHILd questionnaire (version for parents) can be used to assess children's communication difficulties and listening and understanding skills in various home situations. However, for Polish children generally it needs to be verified in other study samples, and take into account specific variables such as cognitive processes, speech development, and hearing status.

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