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Journal of Hearing Science®

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Prof. Henryk Skarzynski, M.D., Ph.D., Dr. h.c. multi

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Milaine Dominici Sanfins, Daniela Gil

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Dear Colleagues,

This first issue of the *Journal of Hearing Science* (*J Hear Sci*) in 2026 encompasses studies that reflect important aspects of contemporary hearing healthcare: from early identification and culturally adapted assessment tools, through therapeutic intervention and epidemiological monitoring, to communication accessibility in everyday clinical settings.

A common theme across these contributions is the need to make hearing care more precise, inclusive, and responsive to real-world needs. A second, equally important theme is standardization. Hearing science needs methods and tools that can function reliably across languages, healthcare systems, and clinical settings, allowing results to be compared, shared, and built upon. Such comparability is essential if we are to expand collective knowledge and translate research findings into better care for patients.

A conference report from the 2nd Eletroescuta Experience in São Paulo further emphasizes the value of international exchange and shared professional experience.

I hope this issue of JHS will inspire further research, clinical reflection, and international collaboration – all aimed at improving diagnosis, treatment, and accessibility for people with hearing and communication difficulties.

With kind regards and greetings,

Prof. Henryk Skarzynski, M.D., Ph.D., Dr. h.c. multi

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Original articles

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NEPALI VERSIONS OF FISHER'S AUDITORY PROBLEMS CHECKLIST AND THE CHILDREN'S AUDITORY PERFORMANCE CHECKLIST

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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
G Funds collection

Abstract

Introduction: Central Auditory Processing Disorder (CAPD) involves deficits in the processing of auditory information within the central nervous system. Children with CAPD remain undiagnosed in Nepal due to a lack of assessment tools. Developing a screening tool for CAPD in the Nepali language is needed to identify at-risk children.

Material and methods: Fisher's Auditory Problems Checklist (FAPC) and the Children's Auditory Performance Checklist (CHAPS) were translated into Nepali using the translation/back-translation method. The questionnaires were administered to 100 students in the Kathmandu valley using cluster sampling. Internal consistency and test–retest reliability analysis were undertaken, and validity was measured in terms of face validity.

Results: Cronbach's alpha was 0.761 for FAPC and 0.949 for CHAPS. All questions received a rating of > 4 from 5 audiologists, confirming their adequacy in terms of content, clarity, and intended purpose. Pearson's *r*-value of 0.998 for CHAPS and 0.775 for FAPC was obtained in test–retest reliability analysis.

Conclusions: The Nepali versions of Fisher's checklist and CHAPS demonstrated good internal consistency, test–retest reliability, and face validity, supporting their use as preliminary CAPD screening tools.

Keywords: screening tool • central auditory processing disorder • CAPD • CHAPS • FAPC

NEPALSKIE WERSJE *LISTY TRUDNOŚCI SŁUCHOWYCH FISHERA* (FAPC) ORAZ *SKALI OCENY PRZETWARZANIA SŁUCHOWEGO U DZIECI* (CHAPS)

Streszczenie

Wprowadzenie: Ośrodkowe zaburzenia przetwarzania słuchowego (CAPD) obejmują deficyty w zakresie przetwarzania informacji słuchowych w obrębie ośrodkowego układu nerwowego. Dzieci z CAPD pozostają w Nepalu niezdiagnozowane z powodu braku odpowiednich narzędzi do oceny. Opracowanie narzędzia przesiewowego w języku nepalskim jest konieczne, aby umożliwić identyfikację dzieci z grup ryzyka.

Materiał i metody: *Listę trudności słuchowych Fishera* (FAPC) oraz *Skalę oceny przetwarzania słuchowego u dzieci* (CHAPS) przetłumaczono na język nepalski metodą tłumaczenia zwrotnego. Kwestionariusze zastosowano u 100 uczniów z doliny Katmandu z zastosowaniem doboru losowego klastrowego. Przeprowadzono analizę rzetelności wewnętrznej oraz test–retest oraz określono trafność fasadową.

Wyniki: Współczynnik alfa Cronbacha wyniósł 0,761 dla FAPC oraz 0,949 dla CHAPS. Wszystkie pytania uzyskały ocenę powyżej 4 od pięciu audiologów, co potwierdza adekwatność pytań pod względem treści, jasności oraz zgodności z zamierzonym celem. W analizie test–retest uzyskano współczynnik korelacji Pearsona $r = 0{,}998$ dla CHAPS oraz $r = 0{,}775$ dla FAPC.

Wnioski: Nepalskie wersje FAPC i CHAPS wykazały dobrą spójność wewnętrzną, wysoką rzetelność test–retest oraz zadowalającą trafność fasadową, co potwierdza ich przydatność jako wstępnych narzędzi przesiewowych w kierunku CAPD.

Słowa kluczowe: narzędzie przesiewowe • zaburzenia ośrodkowego przetwarzania słuchowego • CAPD • CHAPS • FAPC

Key to abbreviations	
AAA	American Academy of Audiology
APDQ	Auditory Processing Domains Questionnaire
ASHA	American Speech-Language-Hearing Association
CANS	central auditory nervous system
CAPD	central auditory processing disorder
CHAPS	Children's Auditory Performance Checklist
CHAPPS	Children's Auditory Processing Performance Scale
CI	confidence interval
FAPC	Fisher's Auditory Problems Checklist
ICC	intraclass correlation coefficient

Introduction

Auditory processing involves identifying the spatial location, nature, and content of sounds, segregating the stimulus from background noise, and interpreting the auditory input [1]. Various components of the central auditory nervous system (CANS) collaboratively function to achieve these tasks [2]. Central auditory processing disorder (CAPD) is a disorder arising from impairment of CANS, leading to challenges in the perceptual processing of auditory information and contributing to delays in various skills, such as learning and language, where effective listening plays a crucial role [3].

The World Health Organization's *Report on Hearing* acknowledges auditory processing disorder as a distinct clinical entity present throughout an individual's lifespan and highlights the adverse impact of the disorder on mental health [4]. Individuals with CAPD are poor listeners [4], inattentive [5], have inconsistent responses to sounds [6], exhibit difficulty understanding rapid speech, have confusion with verbal directions [7], and have trouble recalling events sequentially [8]. The actual incidence and prevalence of CAPD remain uncertain worldwide because there is no universally accepted diagnostic criterion [9] or gold-standard assessment tool [10].

To date, no epidemiological studies have been conducted to estimate the prevalence of CAPD in Nepal. Globally, the prevalence of CAPD in school-age children has been reported to vary widely, ranging from 0.2% [11] to 2.5% [12] in the US and up to 6.2% in New Zealand [13]. A study by Wilson and Arnott [9] found that, depending on the diagnostic criteria and test protocols applied, between 7.3% and 96% of children in Australia referred for auditory processing assessment were identified with CAPD. In India, the prevalence of CAPD is 3.2% in school-aged children [14], which is similar to the 2–5% prevalence in school-aged children reported by Bellis [15]. Some of the known etiological factors include prenatal and neonatal risks (such as cytomegalovirus, low birth weight, neuro-maturational delay), acquired conditions (accidents, chronic otitis media, degenerative disorders, neurological illnesses, improper treatment of hearing loss), aging, genetic factors, and metabolic disorders [16].

Diagnosis of CAPD is a complex process, requiring a combination of psychoacoustic and electrophysiological tests [17] conducted by an audiologist [18]. A test battery approach is recommended for assessing CAPD, as it allows for comprehensively evaluating all auditory processes [19]. A CAPD test battery should include tests of temporal ordering, such as frequency and duration pattern tests, tests of monaural auditory closure, like low-pass filtered speech and other similar measures, and tests of binaural separation and integration, like dichotic tests [20]. In addition, an audiologist needs to take into account various factors when choosing an appropriate central auditory diagnostic test battery, like the linguistic, cognitive, and non-auditory requirements of the auditory assessments, and in the case of children, maturation of the auditory system [18].

Screening questionnaires help identify individuals who are candidates for auditory processing evaluation [21]. The questionnaires assess auditory ability across multiple domains, from directly assessing hearing in different situations to broader cognitive factors that influence auditory processing, including attention and memory. Questionnaires help identify the population most likely to benefit from central auditory assessment, thereby reducing unnecessary testing, lowering costs, and improving the efficiency of diagnosis and rehabilitation [2].

Commonly used CAPD questionnaires for children are the Children's Auditory Performance Scale (CHAPS) [22], Fisher's Auditory Problems Checklist (FAPC) [23], and the Auditory Processing Domains Questionnaire (APDQ) [24]. In one survey, 75% of 195 audiologists reported using questionnaires to screen for the presence of CAPD [25]. Some 63% of them reported they used FAPC, and 51% used CHAPS. These questionnaires have been translated into multiple languages. For instance, Volpatto et al. [26] described the Brazilian Portuguese CHAPS. Garbaruk et al. [27] validated the Russian versions of the CHAPS questionnaire and of Fisher's Auditory Checklist, reporting that parents found Fisher's questionnaire more convenient to complete.

CHAPS was originally called the Children's Auditory Processing Performance Scale (CHAPPS) [22], and consists of 36 questions divided across 6 sub-sections: *Hearing in Noise*, *Quiet*, *Ideal*, and (situations with) *Multiple Inputs*, *Memory*, and *Attention*. The questions are based on the most frequently reported symptoms of CAPD during referral by teachers and parents [21]. They explore the practical listening demands of children, such as responding to questions, listening to someone's dictation, and following commands. Additionally, certain dichotomies, such as simple versus complex directions, listening when attentive versus not attentive, and listening when visual cues are present versus when they are not, are included in the test. Respondents are teachers or parents who are asked to complete the questionnaire comparing the referred child to the listening difficulties faced by children of similar backgrounds and age on a 7-point Likert-type scale that ranges from −5 to +1, where −5 indicates "cannot function at all" and +1 indicates "less difficulty". Besides screening, CHAPS can be useful in prescribing interventions and in measuring the effects of the therapeutic intervention. It is recommended for CAPD screening by the American Speech--Language-Hearing Association (ASHA)[18].

While somewhat narrower in focus than CHAPS, the FAPC offers valuable insights into children's functional listening behaviors within a classroom setting. The checklist is specifically intended for classroom teachers to complete. It is a 25-item questionnaire that employs a straightforward checkmark system to identify auditory behaviors. It yields a single score, which can be categorized as either indicative or non-indicative of the need for further evaluation. It is designed for children aged 5 years to 11 years and 11 months. It is listed as a recommended tool for screening by the American Academy of Audiology (AAA) [28].

CAPD assessment tools have not been developed in the Nepali language to date, meaning that children and adults with CAPD are going undiagnosed. The WHO has emphasized the importance of assessing central auditory processing in individuals with mild hearing loss, as well as in those presenting with normal pure tone audiometry [29]. This is also consistent with the European APD consensus [30]. Audiology as a clinical discipline is still in its early stages in Nepal. Pure-tone audiometry and tympanometry are routinely performed, and higher tests like auditory brainstem response and otoacoustic emissions are limited to a few centers only. Pure tone audiometry does not capture the listening challenges individuals face in everyday environments, but there are screening questionnaires developed for this very purpose. These screening questionnaires are quick to use, inexpensive, and do not require any extra instrumentation. When used in conjunction with routine audiological testing, they can aid in the detection of CAPD in Nepal.

When selecting the CAPD questionnaire to translate, we considered three widely used and validated tools: CHAPS, FAPC, and APDQ. The FAPC was chosen for translation because of its brevity, making it suitable as a quick screening instrument. Both the CHAPS and APDQ offer assessment across multiple scales, providing valuable information even in the absence of diagnostic testing. However, the APDQ contains 52 items compared to 36 in the CHAPS, making the latter more practical and less time-consuming to administer. In addition to these advantages, CHAPS and FAPC are the most widely used tools in both clinical and educational contexts. Therefore, the current study's aims were to translate and validate the CHAPS questionnaire and FAPC checklist in the Nepali language.

Material and methods

Translation of the questionnaires

Evidence shows that health-related questionnaires should not be literally translated into other languages [31]. Such a translation can result in assessing concepts that were not intended to be measured. When measurement tools are used across cultures, they must go beyond accurate linguistic translation. The items also need to be culturally adapted to ensure that the instrument maintains its validity in each cultural context [32]. CHAPS and FAPC are both developed in English, so translating them to Nepali requires cross-cultural adaptation. It is important to ensure that the words in the original questionnaire accurately reflect their intended meaning in the target language [33] as well.

To ensure this, we used the translation/back-translation method [34]. An audiologist translated both tools into the Nepali language (forward translation). The translated questionnaires were then given to a panel of four lecturers specializing in linguistics with expertise in the Nepali language to rate the clarity and syntactic accuracy of the questionnaires on a 5-point rating scale. The scale ranged from 1 ("not clear/inaccurate") to 5 ("extremely clear/highly accurate"). Back-translation to English was performed by a Master's student in linguistics, who was fluent in both English and Nepali but unfamiliar with CHAPS and FAPC, and had no prior involvement in the study.

Each item in the original questionnaires was contrasted with the back-translated version to note any discrepancies between the two. Any discrepancies that were noted were corrected by the authors so that the items in the translated questionnaires contained the same information as the original tests. Then, the translated questionnaires were distributed to 15 native Nepali speakers, with the intent of validating the clarity, linguistic appropriateness, and content of the translated items. In this phase, participants were asked to employ a rating scale with 5 points, ranging from 'appropriate' to 'not appropriate,' to assess each item's clarity. Only those items that were rated as 'appropriate' were retained, and those that received lower ratings were changed to make them appropriate.

For instance, in the CHAPS questionnaire, in the subscale *Multiple Inputs*, examples depicting the listening environment like 'हेरेर + सुनेर' (visual + auditory input) were added in the description of the listening environment after the cohort found it difficult to understand. Examples were also added in question 10 of the FAPC to make it more comprehensible to Nepali teachers and parents. The face validity of the questionnaire was evaluated to ensure its content and clarity. Five qualified audiologists were tasked with rating the items using a 6-point scale, and the items that received a rating of >4 (clear and mostly appropriate) were deemed valid, affirming their adequacy in terms of content, clarity, and intended purpose.

Participants

The sample size was calculated using the single proportion formula [35], assuming a prevalence of CAPD to be 3% based on previous studies [18,36], a 5% margin of error, and a 95% confidence level. This yielded a minimum sample size of 45. In this study, a larger sample of 100 participants was intentionally recruited to improve the precision of the reliability and validity estimates.

A multi-stage sampling method was used for the study. First, a list of all the schools in the Kathmandu district was obtained. The schools were then divided into clusters based on municipalities, and a municipality randomly selected. Finally, simple random sampling was used to select 5 schools within the selected municipality. All selected

Table 1. Descriptive statistics and reliability (Cronbach's alpha) of the CHAPS subscales

Subscales	*N*	Min	Max	*M*	SD	α	CI
Noise	100	–1.43	1.00	0.174	0.6394	0.839	0.81–0.87
Quiet	100	–1.00	1.00	0.447	0.5500	0.862	0.84–0.89
Auditory Memory	100	–1.37	1.00	0.170	0.6212	0.855	0.83–0.89
Auditory Attention	100	–1.62	1.00	0.235	0.5904	0.846	0.82–0.88
Ideal Listening Condition	100	–1.00	1.00	0.705	0.4237	0.609	0.53–0.69
Multiple Input	100	–1.00	1.00	0.387	0.6226	0.750	0.71–0.79
Total	100	–5.00	6.00	2.11	2.80	0.949	0.93–0.96

Note: N = number of samples, Min = minimum, Max = maximum; M = mean score; SD = standard deviation; α = Cronbach's alpha; CI = confidence interval

Table 2. Descriptive statistics and reliability (Cronbach's α) of FAPC

	N	Range	Min	Max	*M*	SD	α	CI
Score	100	24	76	100	87.36	7.52	0.761	0.71–0.80

Note: *N* = number in sample, Min = minimum, Max = maximum; *M* = mean score; *SD* = standard deviation; α = Cronbach's alpha; CI = confidence interval.

schools were English-medium day schools located in urban areas of Kathmandu and predominantly catered to children from middle to upper socioeconomic backgrounds, as indicated by tuition fee structures and school amenities. From each school, 20 students, aged 7 to 17 years, all of whom had an unremarkable audiological history and passed hearing screening, were chosen using a lottery method, and a total sample of 100 students was obtained.

The final sample consisted of 51 males and 49 females with a mean age of 8 years and 11 months (SD = 1 year and 8 months). After obtaining consent from the school principal and parents of the students included in the sample, the Nepali versions of the CHAPS and FAPC were completed by teachers. To support data collection, the teachers were oriented to the questionnaires and instructed to monitor each child's listening behaviors across 3 consecutive days before test administration.

Statistical analysis

SPSS version 25.0 was used for data analysis. Cronbach's alpha was computed to measure the internal consistency of items on both questionnaires, which ensured the reliability of the tests among the Nepali pediatric population. Similarly, the test–retest reliability of the tests was analyzed by computing the intraclass correlation coefficient (ICC). Re-testing was done on 10% of the sample after 4 weeks of initial testing. The level of statistical significance was set at $p < 0.05$. Face validity of the tests was measured by five qualified audiologists who rated the clarity and content of the items using a 6-point rating scale from 1 (indicating "not clear and not appropriate") to 6 ("extremely clear and highly appropriate"). Items that received a rating greater than 4, indicating "clear and mostly appropriate", from all the raters, were considered valid. The relationship between total scores of the FAPC and CHAPS was also examined using Pearson's product–moment correlation coefficient to assess convergent validity.

Results

Children's Auditory Performance Scale

According to the face validity assessment, all items received scores greater than 4, indicating good face validity. The Cronbach alpha of the Nepali CHAPS was 0.949 with a confidence interval: CI = 0.93 to 0.96. The average CHAPS scores across different subscales, along with their corresponding Cronbach's alpha values, are presented in **Table 1**. The overall mean CHAPS total score was 2.11 (SD = 2.80). The mean subscores ranged from 0.17 (*Auditory Memory*) to 0.71 (*Ideal Listening Conditions*), with standard deviations ranging from 0.42 to 0.64. Among the subscales, *Quiet* demonstrated the highest internal consistency (α = 0.862), followed closely by *Noise* (α = 0.839) and *Auditory Memory* (α = 0.855). In contrast, the *Ideal Listening Condition* subscale showed the lowest internal consistency (α = 0.609). Similarly, the intraclass correlation coefficient indicated excellent test–retest reliability for the total score (ICC = 0.923). Ceiling effects were observed in 10 of the 36 items, with more than 15% of participants selecting the highest possible score on these questions. No floor effects were detected in any of the items.

Fisher's Auditory Problems Checklist

According to the face validity assessment, a score greater than 4 was obtained on all items, confirming the validity of FAPC. Descriptive statistics and internal consistency of the FAPC are shown in **Table 2**. The scores ranged from 76 to 100, with a mean of 87.36 (SD = 7.52). The scale demonstrated acceptable reliability, with a Cronbach's α of 0.761 (CI = 0.71–0.80). The overall ICC of 0.717 was obtained suggesting good reliability of the FAPC. Similarly, no ceiling and floor effects were observed in FAPC.

Similarly, Pearson's correlation analysis revealed a statistically significant positive correlation between the total CHAPS and FAPC scores ($r = 0.62$, $p < 0.001$), indicating a strong association and supporting convergent validity between the two instruments.

Discussion

The current study aimed to translate the CHAPS and FAPC questionnaires into Nepali and determine their validity and reliability. The questionnaires were translated into Nepali using a translation/back-translation method, and data was collected from teachers of 100 normal-hearing students. Results indicated that the Nepali versions of CHAPS and FAPC were valid and reliable screening tools for CAPD and can be reliably used for both clinical and research purposes.

CHAPS total scores ranged from –5.00 to 6.00 (mean = 2.11, SD = 2.80). Among the CHAPS subscales, the *Ideal listening* subscale had the highest mean score (0.71, range = –1.00 to 1.00), whereas the *Auditory Memory* subscale had the lowest mean score (0.17, range = –1.37 to 1.00). The pattern of better auditory performance in the ideal conditions and relatively poorer performance when challenged by noise is because the listening and understanding of young children is better in ideal conditions compared to other conditions [21].

Similarly, FAPC scores ranged from 76 to 100, with 7% of participants achieving the maximum possible score. The minimum was obtained by 14% of participants, and the average total score was 87.36. On the FAPC, item 15 ("Has difficulty recalling a sequence that has been heard") showed the highest rate of concern, with 40% of participants reported as experiencing this difficulty. The established normative cut-off values in the literature suggest that children without CAPD score greater than 72% [37] in the FAPC and a total score between –11 and +36 in the CHAPS [20]. In our study, when both questionnaires were administered to the same sample, the findings independently fell within the normative ranges, suggesting the sample is not at risk of CAPD. It also shows the convergence of results and supports the validity of the tests.

Ceiling effects (defined as ≥15% of respondents selecting the highest performance category) were observed in 10 out of 36 items in CHAPS. They include: following simple instructions in noise (Item 3) and under ideal listening conditions (Item 16); listening in a group in noise (Item 7) and in quiet (Item 14); listening to complicated or multiple instructions in noise (Item 4), in quiet (Item 11), and under ideal conditions (Item 17). Ceiling effects were also found on items involving multiple inputs, namely listening while watching the speaker's face (Item 18), listening and reading along while material is read aloud by another (Item 19), and listening while watching an accompanying illustration (Item 20). These items represent common classroom listening situations. As the ratings were provided by teachers for children with normal hearing, these familiar, routine classroom situations were likely perceived as areas of consistently good performance, which may have led teachers to assign uniformly high ratings on these specific items. No floor effects were detected in any item, as none of the respondents selected the lowest response category. Similarly, no ceiling and floor effects were observed in FAPC. This pattern is consistent with the fact that the sample consisted entirely of students without CAPD symptoms.

Reliability and validity are important factors determining the clinical utility of a test. A test should provide a legitimate measure of the function it claims to measure (validity), and it should do so consistently (reliability). Therefore, a test developed to screen for CAPD should consistently assess the integrity of CANS. While both tests are established as reliable and valid in their original versions, it is important to confirm that this is retained in the translated questionnaires. The reliability of the Nepali versions of the tests was evaluated through internal consistency, measured by Cronbach's α, and test–retest reliability calculated using ICC between two administrations of the test 4 weeks apart. We found that the Nepali CHAPS and FAPC have excellent internal consistency. The overall Cronbach α of Nepali CHAPS was 0.949 (CI = 0.93–0.96). Across the subscales in Nepali CHAPS, the *Quiet* section had the highest α (0.862), which suggests a strong internal consistency of that sub-section, and the *Ideal* section had the lowest (0.609). The *Ideal Condition* had a comparatively lower internal consistency in Turkish CHAPS as well. The lower α for the *Ideal Condition* may be due to the reduced variability in children's performance under the optimal listening environments. When most of the responses cluster at the higher end, the restricted range limits inter-item correlations. The α of FAPC was 0.761, which is acceptable, as Cronbach's α values above 0.7 are considered good. Similarly, the test–retest reliability of CHAPS was excellent with a reliability coefficient of 0.998. The Nepali version of FAPC also had good test–retest reliability, with a reliability coefficient of 0.775. Similarly, in the face validity analysis, all items in both the questionnaires received ratings above the minimum acceptable threshold of 4, indicating "clear and mostly appropriate" on a 6-point rating scale when judged by 5 qualified audiologists. The questions were evaluated based on the clarity and representativeness of the intended constructs. The Nepali versions of CHAPS and FAPC also demonstrated good face validity and acceptable convergent validity, indicating that both instruments are appropriate measures of auditory performance and related listening difficulties in the studied population.

The overall Cronbach α of Nepali CHAPS (0.949) is similar to other studies: Turkish CHAPS had α = 0.97 [38], Polish CHAPS had α = 0.97 [39], Arabic had α = 0.99 [40]. The Ideal condition had a comparatively lower internal consistency in Turkish CHAPS, similar to our study. Bayden et al. [38] reported that the Turkish adaptation of CHAPS demonstrated strong reliability and validity, with high internal consistency and a factor structure accounting for 77.8% of the variance in scores. Their translation process followed a translation/back-translation procedure, and data were collected from the parents of 150 children aged 7–15 years. Bieńkowska et al. [39] suggested that the Polish version of CHAPS enables a reliable measurement of hearing as well as understanding difficulties in children. It is also reflected in the Polish version of CHAPS, where the mean scores for *Noise* and *Ideal Conditions* were –0.34 and 0.26, respectively. Arabic CHAPS, like ours, used a 6-point rating scale to assess face validity. The internal consistency of Nepali FAPC was 0.761, which is comparable to Persian FAPC. In the Persian validation of FAPC, 25 children with APD and 25 normal-hearing controls (8–12 years) were included, and the questionnaire had good internal consistency (Cronbach's $\alpha = 0.85$ in the APD group and 0.71 in controls) and acceptable test–retest reliability (ICC = 0.71–0.74). Mean checklist scores clearly differentiated the groups (46.6 in the APD group vs 94.7 in controls), and the questionnaire's effectiveness was further supported by its use alongside the dichotic digit test (DDT) and the word-in-noise test (WNT).

Conclusions

This study has developed reliable and valid Nepali versions of the CHAPS and FAPC questionnaires. These questionnaires are fit for clinical use and help in identifying children who are at risk for CAPD without high cost or long evaluation time. In the future, questionnaires that can be used in the adult population need to be explored. Psychometric evaluation of the Nepali versions and determination of their sensitivity and specificity is also necessary.

Limitations

Individuals may under or overestimate their listening difficulties based on their personality [41]. Some teachers may attribute a child's auditory problems to factors such as motivation and focus [42], whereas others may over-attribute the problems to an auditory origin [43]. Thus, a formal CAPD diagnosis should always include behavioral tests and a multidisciplinary assessment approach. Due to a lack of standardized diagnostic tools for CAPD in the Nepali language, we were unable to independently confirm the presence or absence of CAPD in the sample. We were also unable to recruit a clinical group of students with CAPD in the study and conduct psychometric analyses. The test–retest sample taken in our study was small ($n = 10$), which may not be representative. The possibility of teacher bias also remains, as teachers rated their own students, and blinding was not feasible.

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Conflict of Interest

The authors declare no conflicts of interest.

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Ethical Approval

Ethical approval for this study was obtained from the Institutional Review Committee of the Institute of Medicine, Tribhuvan University, Nepal (reference number 515 (6-11) E2).

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RESULTS OF THE USE OF SPPS-S® (STIMULATION OF POLYMODAL SENSORY PERCEPTION BY SKARZYNSKI) BASED ON 4009 PATIENTS WITH CENTRAL 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
G Funds collection

Abstract

Introduction: Central auditory processing disorder (CAPD) significantly impair auditory, cognitive, and communicative functioning. Effective rehabilitation requires comprehensive therapeutic approaches integrating multisensory stimulation and modern telemedicine solutions. This study aimed to present the Skarzynski's Polymodal Sensory Perception Stimulation (SPPS-S®) method and evaluate its effectiveness based on outcomes from over 4,000 patients with CAPD.

Material and methods: The analysis included 4009 patients who underwent SPPS-S® therapy and a control group of 30 individuals. Auditory processing abilities were assessed using the Frequency Pattern Test (FPT), Duration Pattern Test (DPT), and Dichotic Digit Test (DDT), before and after approximately 3 months of therapy. Statistical analysis was performed using the Wilcoxon signed-rank test.

Results: Statistically significant improvements were observed in all assessed auditory processing parameters following SPPS-S® therapy ($p < 0.05$), in both pediatric and adult populations. No significant changes were found in the control group.

Conclusions: SPPS-S® is an effective, safe, and versatile therapeutic method for CAPD rehabilitation, suitable for both in-clinic and home-based settings, including telemedicine-supported therapy.

Keywords: central auditory processing disorder • CAPD • SPPS-S®

WYNIKI STYMULACJI POLIMODALNEJ PERCEPCJI SENSORYCZNEJ METODĄ SKARŻYŃSKIEGO (SPPS-S®) NA PODSTAWIE WYNIKÓW PONAD 4 TYSIĘCY PACJENTÓW Z CENTRALNYMI ZABURZENIAMI PRZETWARZANIA SŁUCHOWEGO

Streszczenie

Wprowadzenie: Centralne zaburzenia przetwarzania słuchowego (CAPD) istotnie wpływają na funkcjonowanie słuchowe, poznawcze i komunikacyjne. Efektywna forma rehabilitacji wykorzystuje kompleksowe podejścia terapeutyczne, integrując stymulację wielozmysłową oraz nowoczesne rozwiązania telemedyczne. Celem niniejszej pracy było przedstawienie metody Stymulacji Polimodalnej Percepcji Sensorycznej metodą Skarżyńskiego (SPPS-S®) oraz ocena jej skuteczności na podstawie wyników ponad 4000 pacjentów z CAPD.

Materiał i metody: Analiza objęła wyniki ponad 4000 pacjentów poddanych terapii SPPS-S® oraz grupę kontrolną liczącą 30 osób. Procesy przetwarzania słuchowego oceniano za pomocą testu sekwencji częstotliwości (FPT), testu sekwencji czasu trwania (DPT) oraz rozdzielnousznego testu liczbowego (DDT), przed terapią i po jej zakończeniu, po około trzech miesiącach. Analizę statystyczną przeprowadzono z wykorzystaniem testu rang podpisanych Wilcoxona.

Wyniki: Po terapii SPPS-S® zaobserwowano statystycznie istotną poprawę we wszystkich ocenianych parametrach przetwarzania słuchowego ($p < 0,05$), zarówno w populacji dzieci, jak i dorosłych. W grupie kontrolnej nie stwierdzono istotnych zmian.

Wnioski: SPPS-S® jest skuteczną, bezpieczną i wszechstronną metodą terapeutyczną w rehabilitacji CAPD. Może być stosowana zarówno w ośrodkach klinicznych oraz dzięki wykorzystaniu telemedycyny w warunkach domowych.

Słowa kluczowe: centralne zaburzenia przetwarzania słuchowego • CAPD • SPPS-S®

Key to abbreviations	
ADHD	Attention Deficit Hyperactivity Disorder
CAPD	central auditory processing disorder
DDT	Dichotic Digit Test
DPT	Duration Pattern Test
FPT	Frequency Pattern Test
LE	left ear
RE	right ear
SLI	Specific Language Impairment
SPPS-S®	Stimulation of Polymodal Sensory Perception by Skarzynski (Stymulacja Polimodalnej Percepcji Sensorycznej metodą Skarżyńskiego)

Introduction

Central auditory processing disorder (CAPD), according to the definition of the American Speech-Language-Hearing Association [1], is a difficulty in processing auditory information at the level of the central nervous system, despite normal structure and function of the peripheral auditory system. These processes underlie essential auditory skills, including sound localization and lateralization, sound discrimination, recognition of auditory patterns, analysis of the temporal aspects of auditory signals, and temporal integration of sounds. These difficulties, considered as a constellation of symptoms, can significantly affect an individual's daily functioning. The most commonly reported manifestations comprise: difficulty hearing in noisy environments, problems following complex verbal instructions, misperception of similar-sounding words, frequent requests for repetition, challenges in reading and writing, reduced attention span, susceptibility to distraction, and auditory hypersensitivity [2–6].

The difficulties may occur individually or co-occur in varying degrees and forms; however, all can significantly impact multiple aspects of daily life. CAPD is addressed by a wide range of specialists, including otorhinolaryngologists, audiologists, speech-language pathologists, educators, and psychologists [7–9]. The diagnosis is established by a physician, while the patient's rehabilitation, depending on individual needs, involves collaboration with a range of specialists.

Many authors have addressed the diagnosis and the effectiveness of various therapeutic interventions for patients with CAPD across various comorbid conditions [9,10]. Therapies have shown considerable effectiveness in addressing the primary disorder, such as reducing the severity of stuttering and improving central auditory processing abilities [10]. The range of rehabilitation services offered by centers supporting this patient group is continuously expanding, and the market for therapeutic services in the field of auditory training and therapy is growing. The increasing possibilities for rehabilitation interventions are closely linked to the development of telemedicine [11–13].

During the COVID-19 pandemic, access to medical services was significantly restricted. These limitations also affected the availability of various rehabilitation interventions, including in-person auditory therapies, which constitute a primary component of support strategies for children with CAPD.

The auditory therapy used in this study, Stimulation of Polymodal Sensory Perception by Skarzynski (SPPS-S®), is a form of intervention originally designed to be implemented in either remote or in-person format. It has been successfully applied since 2014 in numerous locations across Poland as well as abroad. The SPPS-S® is the only one device on the Polish market to hold medical device compliance certification.

Aim

The aim of this study is to present the method and evaluate its effectiveness based on the outcomes of 4009 patients who have undergone SPPS-S® therapy.

Material and methods

SPPS-S®

Skarzynski's Method of Polymodal Sensory Perception Stimulation (SPPS-S®) is a therapy applied across various groups of disorders comorbid with CAPD. According to the literature, auditory processing difficulties affect perhaps several percent of the school-aged population; however, in children with dyslexia, problems with auditory processing may occur in over 30% of cases [6,14], and in children diagnosed with SLI or ADHD, this figure can reach up to 50% [3,15].

SPPS-S® is designed to perform therapy on multiple levels simultaneously. Various human senses – hearing, vision, and touch – are engaged, with the aim of integrating and coordinating them. The SPPS-S® approach is to supply simultaneous stimulation.

SPPS-S® therapy consists of three levels, but in cases of insufficient improvement, there is the possibility of continuing the stimulation. Each level of therapy lasts 4, 5, or 10 days. The therapy is composed of three components: listening to audio material processed through the device, relaxation, and multimedia and psychoeducational games conducted on a tablet.

During the listening phase, patients are exposed to the processed audio material. In the first two levels, their task is passive listening. During this time, they may engage in various manual activities, play games, assemble blocks, or participate in other activities. In the next stage, relaxation, patients listen to a narrator's voice accompanied by relaxing music while assuming a comfortable position, preferably lying down. The third stage of therapy involves multimedia and psychoeducational games. The multimedia games primarily target auditory skills such as sound intensity discrimination; sound frequency discrimination; sound duration discrimination; auditory memory; sound localization; and other related skills. The audio material used in the games is based on environmental sounds; instrumental/music sounds; and speech sounds.

An innovative aspect is the combination of auditory stimulation with psychological training. Emotions play a crucial role in communication, and disturbances in this domain constitute one aspect of CAPD. Misinterpretation in verbal communication can not only lead to misunderstandings and affect social relationships but may also significantly impact an individual's self-esteem, since communication difficulties accumulate and contribute to a sense of being misunderstood. Integrating psychological therapy with auditory function training provides a much greater potential for effectively supporting individuals struggling with auditory processing difficulties.

Qualification for the SPPS-S program and programming of therapy were performed using the SPPS-S® panel as well as disorder-specific standardized forms. This arrangement was intended to support collection of diagnostic information and therapy programming in a uniform way, one which is suitable for routine clinical practice. The SPPS® Panel is available via a dedicated website accessible only to certified therapists, where patient diagnostic data are entered in the appropriate sections. For each disorder group for which SPPS-S® therapy programs have been developed, separate data entry sheets have been prepared. These sheets include forms for entering additional disorder-specific information, such as articulation assessment (for dyslalia and delayed speech development) or phonemic hearing evaluation (for reading and writing disorders). However, for all groups, the mandatory data required to initiate SPPS-S® therapy are the results of the following tests assessing central auditory processing.

- **FPT (Frequency Pattern Test)** – a test for discriminating sequences of sounds differing in frequency. The test includes 40 random sequences, each consisting of three sequential tones, one of which differs in frequency from the others (high tone – 1122 Hz, low tone – 880 Hz), presented at an intensity of 50 dB HL. This test evaluates the ability to discriminate sound frequencies as well as short-term auditory memory. During the test, the patient's task is to report the order of tones in each sequence. The maximum score is 100% [16].
- **DPT (Duration Pattern Test)** – a test for discriminating sequences of sounds differing in duration. The test includes 40 sequences, each consisting of three tones, one of which differs in duration from the others (long tone – 500 ms, short tone – 250 ms), presented at an intensity of 50 dB HL. This test assesses the ability to discriminate sound duration and short-term auditory memory. During the test, the patient's task is to report the order of tones in each sequence. The maximum score is 100% [17].
- **DDT (Dichotic Digit Test)** – a dichotic digit test in which the patient repeats 20 pairs of digits presented binaurally. This test evaluates the integration of information from both ears and the transfer of that information between brain hemispheres. During the test, the patient hears two pairs of digits simultaneously, different for the right and left ears. Results are reported separately for the right ear (RE) and the left ear (LE). The maximum score is 100% for the right ear and for the left [17].

SPPS-S® therapy can be conducted either in a therapeutic center or at home (in-person or remote format). The device itself, along with therapy programming and various technical solutions (e.g., inter-training interval locks, supervised access, the possibility of remote connection to the SPPS-S® set), as well as device certification, mean that the therapy can be safely and effectively conducted at home after appropriate parent/caregiver training.

The effectiveness of both formats has been demonstrated in a publication [18] comparing the outcomes of patients undergoing remote versus in-person therapy. Statistically significant therapeutic effects were observed, and the effect size (ES) parameter was above 0.8 for both therapy formats, confirming that both approaches delivered a very high therapeutic effect.

The choice of therapy format is determined by several factors. The most important is based on the patient's difficulties and capabilities – for example, group therapy may be advantageous in some cases, or, at other times, inappropriate. In some situations, the home-based format is chosen due to the family's daily schedule or the high costs associated with frequent travel to the diagnostic and rehabilitation center.

The present retrospective cohort included patients treated in both formats. The choice of format was individualized according to the patient's needs, family circumstances, and organizational factors. The present analysis pooled both formats and was not designed to compare them within this cohort.

Material

The material comprised the results of 4,402 patients: children (aged 6–18) and adults (aged 19–52). The study group consisted of 4,372 individuals, while the control group included 30 patients. The study was retrospective. In both the study and comparison groups, inclusion criteria were: normal peripheral hearing, a clinical diagnosis of CAPD with reported and clinically observed symptoms, and normal intellectual functioning. Patients in the study group underwent SPPS-S® therapy (in either a therapeutic center or remotely) whereas the control group consisted of patients who had been qualified for auditory therapy but were awaiting its initiation.

Patients in the study group were assessed before and after completion of SPPS-S® therapy, i.e., after approximately 3 months. The same two measurements (baseline and follow-up) were obtained in the control group, in which no auditory therapy or other auditory rehabilitation interventions were administered during the interval between assessments. At the end of the study period all participants in the control group began SPPS-S® therapy.

Statistical analysis

Statistical analysis was performed using IBM SPSS Statistics (version 25). Descriptive statistics were calculated for quantitative variables. A nonparametric Wilcoxon test was applied to the FPT, DPT, and DDT tests to estimate changes before and after therapy. A p-value of < 0.05 was considered statistically significant.

Results

Results from 4,372 patients who underwent SPPS-S® therapy were obtained based on diagnostic assessments conducted before and after therapy. The tests assessing central auditory processing were FPT, DPT, DDT RE, and DDT LE. However, complete data for all tests (8 measurements: 4 before therapy and 4 afterwards) were only available for 4,009 patients. At the time of the initial assessment, the minimum patient age was 6 years and the maximum was 52 years. Mean age of children was 9.26 years ($SD = 2.33$) and mean age of adults was 32.6 years ($SD = 10.1$). All test results are expressed as percentage correct, where 100% is the maximum possible score.

Table 1 presents the results of all patients who underwent SPPS-S® therapy. The results for the subgroup of children, consisting of 3,892 individuals, are presented in **Table 2**. The results for the adult patient group, consisting of 117 individuals, are presented in **Table 3**.

Statistical analyses of patient outcomes demonstrated that SPPS-S® therapy resulted in a statistically significant improvement in all assessed auditory functions.

Table 4 presents the before and after measurements in the control group, which consisted of 30 children who did not undergo any auditory stimulation, therapy, or other rehabilitation interventions. These patients were tested twice: at the first measurement and at a second measurement approximately 3 months later. No statistically significant differences were observed between the results of the first and second measurements.

Discussion

The aim of this study was to use the SPPS-S® method and evaluate its effectiveness based on the outcomes of over 4,000 patients who underwent therapy. Statistical analyses demonstrated a statistically significant improvement in all parameters assessing central auditory processing in the study group before and after SPPS-S® therapy. The therapeutic effects were positive in both adults and children, with particularly strong improvements observed in children. Although the therapeutic outcomes in adults were also statistically significant, baseline test results prior to therapy were higher than with children, resulting in less pronounced changes in these parameters.

These findings support the importance of early identification and timely rehabilitation planning in patients with auditory processing difficulties. According to Katz [19], CAPD is characterized by an inability to fully utilize the acoustic signal despite normal peripheral hearing. Patients function similarly to individuals with a mild degree of hearing loss, and the resulting difficulties can affect all areas of life. Therefore, prompt initiation of rehabilitation interventions is important. According to Bellis [2], therapy for patients with CAPD should be based on three main pillars: (1) auditory training targeted at specific deficits; (2) modification of the patient's functional environment; (3) compensation for and extra support of existing difficulties.

The most important area is the use of auditory training to improve impaired auditory skills. The available literature includes studies demonstrating the effectiveness of various types of auditory stimulation, such as Johansen therapy, the Safe and Sound Protocol, and the Tomatis Method [20–22]. Authors of numerous studies have demonstrated the impact of auditory training on specific brain regions [23,24], brain functioning [25,26], brain development [27,28], auditory processing [29,30], as well as on dyslexia-related disorders [31]. In one study, Rosińska et al. [10] demonstrated the effectiveness of developed auditory stimulation for patients who stutter, assessing the reduction in stuttering severity using four tests: the Cooper Questionnaire [32], the Syllable Test [33], the Dichotic Listening Test [34], and the Dichotic Digit Test [35]. Mularzuk et al. [36] demonstrated the effectiveness of the Tomatis Method in a large group of 422 first-grade students, based on an assessment of an attention test and an auditory lateralization test. Experimental and clinical studies have demonstrated that auditory training may provide measurable improvement in both behavioral test outcomes and neurophysiological parameters (such as auditory brainstem responses and cortical auditory evoked potentials). These changes can be interpreted as evidence of adaptive reorganization within the neural networks responsible for the analysis and integration of acoustic stimuli [37].

Comparing the effectiveness of available programs is not possible, mainly due to differences in diagnostic methods and qualification criteria. It should also be noted – although this is not sufficiently emphasized – that with most auditory training programs or therapies, qualifying for therapy does not equate to establishing a clinical diagnosis. Different therapeutic techniques typically have different patient inclusion criteria, usually specific to the method. Sometimes, multiple methods may be appropriate for a patient, so it is worth considering separate certification and clinically based diagnosis (as is the case with the SPPS-S®).

Given the wide range of auditory rehabilitation methods, each with their own unique features, a decision regarding appropriate therapy should be left to a certified therapist or specialists with suitable qualifications. The therapies vary in many aspects such as theoretical assumptions, inclusion and exclusion criteria, and formats (in clinic

Table 1. Effects of therapy – all respondents combined (study group) based on a Wilcoxon signed-rank test

Average results	FPT (*n* = 4009)			DPT (*n* = 4009)			DDT RE (*n* = 4009)			DDT LE (*n* = 4009)		
	M	**Median**	**SD**	***M***	**Median**	**SD**	***M***	**Median**	**SD**	***M***	**Median**	**SD**
Before	35.60	30.00	24.14	39.90	35.00	25.31	71.86	75.00	18.88	53.68	55.00	21.37
After	54.65	53.00	24.99	58.00	57.50	24.47	78.82	80.00	15.42	67.41	70.00	18.34
p	< 0.001			< 0.001			< 0.001			< 0.001		
Z	–48.31			–48.54			–27.83			–44.91		
ES	0.76			0.77			0.44			0.71		

Note: *n* – sample size; *p* – *p*-value; *Z* – Wilcoxon signed-rank test; ES – effect size; RE – right ear; LE – left ear.

Table 2. Effects of therapy in 3892 children in the study group

Average results	FPT (*n* = 3892)			DPT (*n* = 3892)			DDT RE (*n* = 3892)			DDT LE (*n* = 3892)		
	M	**Median**	**SD**	***M***	**Median**	**SD**	***M***	**Median**	**SD**	***M***	**Median**	**SD**
Before	34.16	28.00	23.81	38.48	33.00	25.24	70.73	75.00	20.01	52.58	53.00	21.75
After	53.21	50.00	25.19	56.60	55.00	24.92	77.80	80.00	16.54	66.37	67.50	18.88
p	< 0.001			< 0.001			< 0.001			< 0.001		
Z	–47.90			–47.95			–27.37			–44.27		
ES	0.77			0.77			0.45			0.71		

Note: *n* – sample size; *p* – *p*-value; *Z* – Wilcoxon signed-rank test; ES – effect size; RE – right ear; LE – left ear.

Table 3. Effects of therapy in 117 adults in the study group

Average results	FPT (*n* = 117)			DPT (*n* = 117)			DDT RE (*n* = 117)			DDT LE (*n* = 117)		
	M	**Median**	**SD**	***M***	**Median**	**SD**	***M***	**Median**	**SD**	***M***	**Median**	**SD**
Before	71.61	65.00	29.40	62.1	67.5	27.66	79.46	85.0	16.80	63.20	66.00	25.88
After	74.91	83.00	24.99	77.17	82.75	21.35	87.39	92.5	23.10	76.57	82.75	22.26
p	< 0.001			< 0.001			< 0.001			< 0.001		
Z	–6.31			–7.47			–5.12			–7.51		
ES	0.58			0.69			0.47			0.69		

Note: *n* – sample size; *p* – *p*-value; *Z* – Wilcoxon signed-rank test; ES – effect size; RE – right ear; LE – left ear.

Table 4. Before and after measurements in the control group (no auditory therapy administered during the observation period)

Average results	FPT (*n* = 30)			DPT (*n* = 30)			DDT RE (*n* = 30)			DDT LE (*n* = 30)		
	M	**Median**	**SD**	***M***	**Median**	**SD**	***M***	**Median**	**SD**	***M***	**Median**	**SD**
Before	27.00	65.00	21.50	35.17	67.5	21.24	73.33	85.0	19.41	49.83	66.00	22.97
After	26.83	83.00	23.49	33.83	82.75	30.12	70.58	92.5	19.87	45.00	82.75	22.20
p	0.890			0.523			0.221			0.054		
Z	–0.14			–0.64			–1.13			–1.92		
ES	0.03			0.12			0.21			0.35		

Note: *n* – sample size; *p* – *p*-value; *Z* – Wilcoxon signed-rank test; ES – effect size; RE – right ear; LE – left ear.

or at the patient's home, and individually or in groups). Training can also take the form of passive exercises that don't require active cooperation or active exercises that do.

This study has several limitations. First, it was retrospective, non-randomized, and non-blinded, which limits causal inference. Second, the waiting-list comparison group was small and not formally matched to the treatment cohort. Third, the cohort was heterogeneous with respect to age and comorbid conditions, and no subgroup analyses beyond children versus adults were performed. Fourth, detailed adverse-event/safety outcomes were not formally analyzed. These limitations should be considered when interpreting the findings.

In future studies, the authors plan to include long-term therapeutic effects, detailed surveys, a larger control group, and perhaps a placebo group. Future prospective studies should also include random allocation and blinded outcome assessments to strengthen the validity of the findings. The coexistence of CAPD with other diseases is also a factor that may influence the effects of therapy and needs to be taken account of in future studies.

Conclusions

This study presents the results of 4,009 patients who underwent therapy using the SPPS-S® method. In this large retrospective clinical cohort, SPPS-S® therapy was associated with a statistically significant improvement across all evaluated central auditory processing measures. These findings suggest that SPPS-S® may be a promising therapeutic option for patients with CAPD who are being treated either in-person or in a remote setting. However, the observational design, lack of blinding, and small control group mean that the results should be interpreted with caution and confirmed in prospective randomized studies.

Conflict of interests

The method presented in this manuscript was originally developed by Henryk Skarzynski, whose surname forms part of the method's name. Because both Henryk Skarzynski and Piotr H. Skarzynski are co-authors of this article, this circumstance may reasonably be viewed as a potential competing interest. The authors declare that this relationship did not influence the study design, data interpretation, or conclusions.

Ethics statement

The study received approval from the Bioethics Committee KB/07/2017. Informed consent was not required due to the retrospective nature of the study.

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TRENDS OF MORBIDITY AND MORTALITY IN POLAND FROM MALIGNANT TUMORS OF THE NASAL CAVITY AND MIDDLE EAR (ICD-C30)

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Abstract

Introduction: The aim of the study was to compare the incidence and mortality in Poland from malignant tumors of the nasal cavity and middle ear (ICD-C30) with other head and neck cancers over the years 2000 to 2022.

Material and methods: Incidence and death due to malignant tumors in Poland was based on data from the Polish National Cancer Registry (KRN) over the years 2000, 2005, 2010, 2015, 2020, and 2022. As a benchmark, we compare worldwide rates from the latest GLOBOCAN estimates developed by the International Agency for Research on Cancer (IARC) and distributed as Cancer Today in the Global Cancer Observatory.

Results: Based on figures from the Polish National Cancer Registry for the years 2000 and 2022, the incidence of malignant tumors of the nasal cavity and middle ear in the country has increased by 18.1%, with an increase of 15.5% in women and 20.4% in men. In terms of deaths from such tumors, however, the same source showed an overall increase of 33.3%, which comprised 56.2% for women and 20.7% for men.

Conclusions: A malignant tumor of the nasal cavity and middle ear (ICD-C30) is the 20th most common cancer of the head and neck. The Polish National Cancer Registry from 2022 shows that ICD-C30 is the 19th most common cancer of the head and neck in terms of deaths, comparable with malignant tumor of the gums (ICD-C03). In terms of incidence, the most common head and neck cancer based on the same source is thyroid cancer (ICD-C73), and in terms of deaths, laryngeal cancer (ICD-C32).

Keywords: incidence • mortality • malignant tumors • nasal cavity • middle ear

TRENDY ZACHOROWALNOŚCI I ŚMIERTELNOŚCI W POLSCE Z POWODU NOWOTWORÓW ZŁOŚLIWYCH JAMY NOSOWEJ I UCHA ŚRODKOWEGO (ICD-C30)

Streszczenie

Wstęp: Celem badania było porównanie częstości występowania i śmiertelności z powodu nowotworów złośliwych jamy nosowej i ucha środkowego (ICD-C30) w Polsce z innymi nowotworami głowy i szyi w latach 2000–2022.

Materiały i metody: Dane dotyczące zachorowalności i śmiertelności z powodu nowotworów złośliwych w Polsce oparto na informacjach pochodzących z Krajowego Rejestru Nowotworów (KRN) za lata 2000, 2005, 2010, 2015, 2020 i 2022. Jako punkt odniesienia porównujemy wskaźniki światowe z najnowszych szacunków GLOBOCAN opracowanych przez Międzynarodową Agencję Badań nad Rakiem (IARC) i opublikowanych jako Cancer Today w Global Cancer Observatory.

Wyniki: Na podstawie danych z KRN z lat 2000 i 2022 częstość występowania nowotworów złośliwych jamy nosowej i ucha środkowego w kraju wzrosła o 18,1%, przy czym wzrost ten wyniósł 15,5% wśród kobiet i 20,4% wśród mężczyzn. Jeśli chodzi o zgony spowodowane tymi nowotworami, to jednak to samo źródło wykazało ogólny wzrost o 33,3%, z czego 56,2% dotyczyło kobiet, a 20,7% mężczyzn.

Wnioski: Nowotwór złośliwy jamy nosowej i ucha środkowego (ICD-C30) jest dwudziestym najczęściej występującym nowotworem głowy i szyi. Z danych KRN za rok 2022 wynika, że ICD-C30 zajmuje dziewiętnaste miejsce pod względem liczby zgonów wśród nowotworów głowy i szyi, plasując się na podobnym poziomie co nowotwór złośliwy dziąseł (ICD-C03). Pod względem zachorowalności najczęstszym nowotworem głowy i szyi według tego samego źródła jest rak tarczycy (ICD-C73), a pod względem zgonów – rak krtani (ICD-C32).

Słowa kluczowe: zachorowania • zgony • nowotwory złośliwe • jama nosowa • ucho środkowe

Introduction

Head and neck cancer is the general name for malignant and benign tumors located in the area from the base of the skull to the clavicles, excluding the brain [1]. According to the international classification of diseases ICD-10, these are diseases corresponding to the codes C00–C15, C30–C33, C69, and C73 [2]. The ICD-C30 code corresponds to malignant tumors of the nasal cavity and middle ear, which are included together.

According to current data from the Polish National Cancer Registry, 10,801 people in Poland were diagnosed with head and neck cancer in 2013 and 5990 died; they accounted for 8% of all cancers diagnosed in men and 5% in women [3]. In Poland, similar to other European countries, a new epidemiological phenomenon is being observed, i.e., an increase in the number of new cases of head and neck cancer in people under 40 years of age who have never smoked or abused alcohol [4]. The growing incidence of head and neck cancer is primarily due to human papillomavirus (HPV). At the same time, it is surprising that many people still do not associate HPV with cancer (e.g., of the tongue).

Comprehensive nationwide analyses integrating multiple anatomical locations over extended periods of time are in fact limited, although reports from national registries and partial epidemiological studies do exist. Publications are fragmentary and concern only a given region or clinical center [1,2]. Figures on epidemiology of morbidity and mortality for Poland are based on the Polish National Cancer Registry.

The aim of this study was to analyse incidence and mortality due to malignant tumors of the nasal cavity and middle ear (ICD-C30) in Poland and compare them with other head and neck cancers in the country for the years 2000 to 2022.

Material and methods

The analysis of incidence and death due to malignant tumors in Poland was based on data from the Polish National Cancer Registry [3] for the years 2000 to 2022. The study included data for the following years: 2000, 2005, 2010, 2015, 2020, and 2022. For comparison with global data, figures on malignant tumors as reported in the latest GLOBOCAN estimates developed by the International Agency for Research on Cancer (IARC) and distributed as Cancer Today in the Global Cancer Observatory were used [5].

The incidence and mortality due to malignant tumors, including head and neck cancers, in 2000 and 2022, were statistically analysed. A Cochran–Armitage test for trend was performed. The following mathematical formulas were used in statistical calculations:

$$p = \frac{m}{n} \times 100\% \quad (1)$$

where: p is the proportion, m is the number of deaths due to head and neck cancer, n is the number of deaths due to all malignant tumors.

$$C = \frac{x_{2022} - x_{2000}}{x_{2000}} \times 100\% \quad (2)$$

where: C is the relative change, x_{2000} is the number of deaths in 2000, x_{2022} is the number of deaths in 2022.

$$G = \left(\frac{x_{2022}}{x_{2000}}\right)^{\frac{1}{n}} - 1 \times 100\% \quad (3)$$

where: G is the geometric mean, n is the number of periodic measurements, taken individually six times, in 2000, 2005, 2010, 2015, 2020, and 2022), x_{2000} and x_{2022} as above.

Proportions and relative growth were manually calculated when needed. MedCalc version 23.4 was used for all the statistical computations (MedCalc Software Ltd, Ostend, Belgium).

The study was a retrospective study and did not require the consent of the bioethics committee.

Results

Epidemiological data on the incidence of malignant tumors in Poland according to the Polish National Cancer Registry (data for 2000) indicate (**Table 1**) that the incidence of malignant tumors of the nasal cavity and middle ear (ICD-C30) involved 94 cases, which constituted 0.08% of all cases of malignant tumors.

The incidence of ICD-C30 cases in women involved 45 cases, which constituted 0.08% of all cancer cases and corresponding figures for men amounted to 49 cases, again 0.08% of all cases of malignant tumors.

So far as deaths are concerned, the data for 2000 from the Polish National Cancer Registry show that deaths in Poland due to ICD-C30 amounted to 45 cases, which constituted 0.05% of all deaths. For women, there were 16 cases, which was 0.04% of all deaths due to malignant tumors (**Table 1**). In men, the corresponding figures were 29, which was 0.06% of all deaths due to malignant tumors.

Data for other years is also given in **Table 1**, where the figures for 2022 showed an incidence of 111 cases of ICD-30, which was 0.06% of all cases of malignant tumors. The total included 52 women and 59 men. For deaths, there were 60 cases due to ICD-C30, which was 0.06% of all deaths due to malignancy. The total comprised 25 women and 35 men, which respectively constituted 0.06% and 0.07% of all deaths due to malignant tumors.

Table 1. Incidence and mortality due to malignant tumors of the nasal cavity and middle ear (ICD-C30) in selected years in Poland (National Cancer Registry, accessed 1 October 2025)

Years	Incidence		Mortality		Total	
	Women	Men	Women	Men	Incidence	Mortality
2000	45	49	16	29	94	45
2005	45	55	28	28	100	56
2010	33	61	25	21	94	46
2015	62	60	28	28	122	56
2020	47	65	18	33	112	51
2022	52	59	25	35	111	60

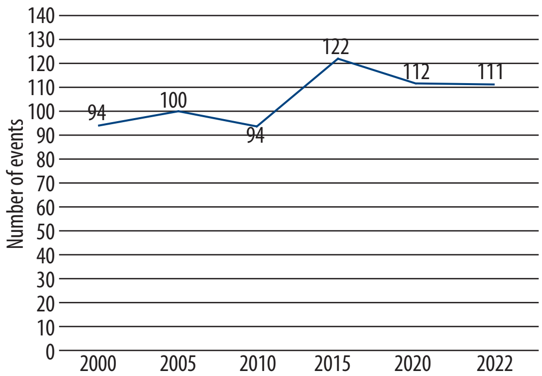

Figure 1. Incidence of malignant tumors of the nasal cavity and middle ear since 2000 in Poland (National Cancer Registry, accessed 1 September 2025). The average increase over the entire period is 18.1%

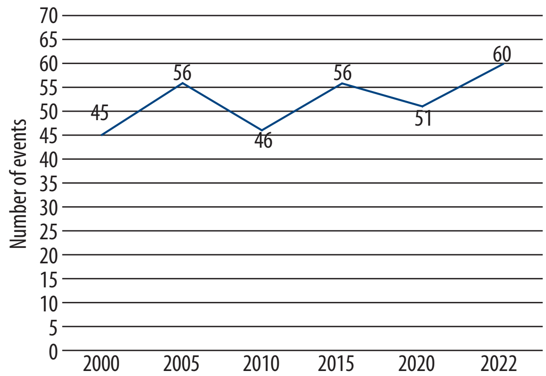

Figure 2. Mortality due to malignant tumors of the nasal cavity and middle ear since 2000 in Poland (National Cancer Registry, accessed 1 September 2025). The average increase over the entire period is 33.3%

Figure 1 shows that from 2000 to 2022 the incidence of malignant tumors of the nasal cavity and middle ear increased by 18.1% ($p = 0.047$). The average rate of growth was 4.2% per measurement interval. Turning to mortality, **Figure 2** shows that the rate of mortality due to ICD-C30 increased by 33.3% from 2000 to 2022 ($p = 0.9159$). The average increase per measurement interval was 7.5%.

Data for 2000 shows that, according to the Polish National Cancer Registry, the incidence of all cancers in Poland was 118,869, including 7,775 incidences of head and neck cancer, representing 6.54% of all cases (**Table 2**). The total number of malignant tumors in women was 57,925 cases, including 2485 cases of head and neck cancer, some 4.29%. For men, the total was 60,944, including 5,290 cases of such cancers (8.68%).

The Polish National Cancer Registry also indicates that in 2000 there were 87,826 deaths in Poland from all malignant tumors, including the deaths of 3,820 due to cancers of the head and neck (4.35%). The figure of 3,820 was made up of 3,025 men and 795 women.

Figures for 2022 are shown in **Table 3**. In that year there were 395,538 incidences of all malignant tumors, of which 12,100 were cases of the head and neck (3.06%). There were a total of 51,190 cases of malignant tumors, according to the Polish National Cancer Registry, including 3,025 men who incurred head and neck tumors (6.30%). The total number of female cases was 228,240, of which 6,094 were head and neck cancer (2.67%) and in men there were 167,298 malignant cases, of which 6,006 were of the head and neck (3.59%).

In terms of deaths, data show that there were 96,127 deaths due to all malignant tumors, including 4,989 deaths due to head and neck cancers (5.2%). Deaths of women totalled 44,223, of which 1,309 were from tumors of the head and neck (2.96%) (**Table 3**). For men, there were a total of 51,904 deaths, including 3,680 men who died of head and neck tumors (7.09%).

Based on the 2022 figures, it appears that malignant tumors of the nasal cavity and middle ear (ICD-C30) is the 20th most common cancer in terms of incidence, i.e. the least common cancer, rating 13th in women and 20th in men. Moreover, the data shows that malignant tumor of the oral cavity, nasal, and middle ear (ICD-C30) in terms of deaths rate 19th [3], along with malignant tumor of the gums (ICD-C03). In women, the rating was 16th, along

Table 2. Summary of incidence and mortality due to head and neck cancer in 2000 (number of cases from National Cancer Registry, accessed 1 October 2025)

ICD	Location of organ	Incidence		Mortality		Total	
		Women	Men	Women	Men	Incidence	Mortality
C00	Oral lip	104	471	19	124	575	143
C01	Root of the tongue	16	69	3	59	85	62
C02	Other parts of the tongue	70	280	48	210	350	258
C03	Gum	34	57	13	22	91	35
C04	Floor of the mouth	43	249	27	159	292	186
C05	Palate	27	71	7	41	98	48
C06	Unspecified parts of the mouth	41	68	29	61	109	90
C07	Parotid gland	104	122	36	54	226	90
C08	Unspecified major salivary glands	54	59	17	51	113	68
C09	Palatine tonsil	68	268	27	176	336	203
C10	Oropharynx	46	208	13	64	254	77
C11	Nasopharyngeal part	47	139	43	81	186	124
C12	Piriform recess	2	22	–	7	24	7
C13	Laryngeal part of the pharynx	23	167	9	103	190	112
C14	Other unspecified locations in the throat	21	113	40	147	134	187
C30	**Nasal cavity and middle ear**	**45**	**49**	**16**	**29**	**94**	**45**
C31	Paranasal sinuses	40	80	27	48	120	75
C32	Larynx	325	2412	165	1465	2737	1630
C69	Eye	123	105	39	40	228	79
C73	Thyroid	1252	281	217	84	1533	301
Total	Head and neck cancers	2485	5290	795	3025	7775	3820

with malignant tumor of the palate (ICD-C05) and unspecified tumor of the large salivary glands (ICD-C08), while in men it rated 20th [3]. The most common head and neck cancer based on the National Cancer Registry of 2022 in terms of incidence is thyroid cancer (ICD-C73), and in terms of deaths, laryngeal cancer (ICD-C32) (**Table 3**). Deaths from laryngeal cancer are more common in men than in women (by a factor of 6.7 times). Malignant laryngeal cancer in men is the 11th most common malignant tumor in the Polish National Cancer Registry of 2022 in terms of incidence and deaths.

Figure 3 shows the incidence rates of IDC-C30 for women and men for 2000 and 2022, and the differences between the sexes are not significant ($p = 0.4522$). From 2000 to 2022, the incidence due to malignancies of the nasal cavity and middle ear increased by 15.6% in women ($p = 0.2022$) and in men by 20.4% ($p = 0.8424$).

For mortality, **Figure 4** shows that the differences between women and men due to cancers of the nasal cavity and middle ear were not significant ($p = 0.5273$). From 2000 to 2022, the mortality due to malignant neoplasms of the nasal cavity and middle ear increased in women by 56.3% ($p = 0.8688$) and in men by 20.7% ($p = 0.9746$).

Discussion

Forecasts from the Polish Health Needs Map indicate that head and neck cancers will increase from 2022 to 2031. In 2022, the recorded incidence was 7,600, and by 2031, it is expected to increase by 10.5% to 8,400 [4]. In comparison, incidence data from the Polish National Cancer Registry for 2000 [3] showed that malignant tumors of the nasal cavity and middle ear increased by 18.1% in 2022, with a slight increase of 15.5% in women and 20.4% in men. Based on the Polish National Cancer Registry of 2022, men are more likely to suffer from malignant tumors of the nasal cavity and middle ear than women (by a factor of 1.13).

In terms of mortality, data for 2000 from the Polish National Cancer Registry [3] show that deaths due to IDC-C30 increased by 33.3% in 2022, with an increase of 56.2% in women and 20.7% in men. Based on the Polish

Table 3. Summary of the number of incidence and mortality due to head and neck cancer in 2022 (National Cancer Registry, accessed 1 October, 2025)

ICD	Location of organ	Incidence		Mortality		Total	
		Women	Men	Women	Men	Incidence	Mortality
C00	Oral lip	81	203	28	75	284	103
C01	Root of the tongue	54	193	47	160	247	207
C02	Other parts of the tongue	209	422	122	293	631	415
C03	Gum	52	61	23	37	113	60
C04	Floor of the mouth	108	393	95	281	501	376
C05	Palate	50	89	25	52	139	77
C06	Unspecified parts of the mouth	131	193	78	121	324	199
C07	Parotid gland	146	158	65	98	304	163
C08	Unspecified major salivary glands	72	68	25	42	140	97
C09	Palatine tonsil	231	543	93	308	774	401
C10	Oropharynx	66	234	60	218	300	278
C11	Nasopharyngeal part	52	106	36	80	158	116
C12	Piriform recess	23	165	14	84	188	98
C13	Laryngeal part of the pharynx	40	229	42	232	269	274
C14	Other unspecified locations in the throat	30	119	32	116	149	148
C30	**Nasal cavity and middle ear**	**52**	**59**	**25**	**35**	**111**	**60**
C31	Paranasal sinuses	57	92	33	65	149	98
C32	Larynx	267	1525	181	1214	1792	1395
C69	Eye	266	249	76	59	515	135
C73	Thyroid	4107	905	209	110	5012	319
Total	Head and neck cancers	6094	6006	1309	3680	12100	4989

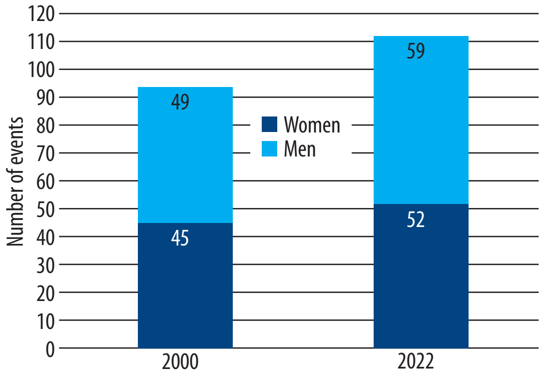

Figure 3. Incidences, by gender, of malignant tumors of the nasal cavity and middle ear against the background of all malignant tumors in 2000 and 2022 (National Cancer Registry, accessed 1 September 2025). There is no statistical difference between the increases for men and women

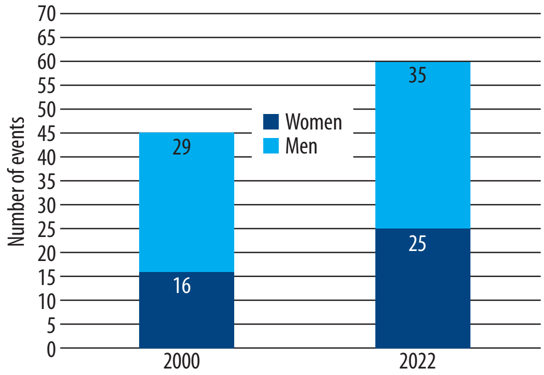

Figure 4. Mortality, by gender, due to malignant tumors of the nasal cavity and middle ear in 2000 and 2022 (National Cancer Registry, accessed 1 September 2025). There is no statistical difference between the increases for men and women

National Cancer Registry of 2022, deaths from cancer of the nasal cavity and middle ear are more common in men than in women (by 1.4 times).

Head and neck cancers are still diagnosed in stages III and IV, regardless of when they began. For these patients, medical treatment can only be palliative, with the aim being just to prolong life and improve comfort.

Data from the Polish National Cancer Registry show that from 2000 to 2022 the incidence of head and neck cancers increased by 55.6% (by 145.2% in women and 13.5% in men). Based on the Polish National Cancer Registry of 2022, women are slightly more likely to suffer from head and neck cancer than men, but only by 1.44%. For deaths, data from the Polish National Cancer Registry [3] show that there was an increase of head and neck cancer from 2000 to 2022 by 30.6% (by 64.7% in women and 21.7% in men). Based on the Polish National Cancer Registry of 2022 [3], deaths from head and neck cancer are more common in men than in women by 2.8 times.

Age is the strongest risk factor for cancer. It increases in both sexes with age. The risk of developing the disease is highest in both men and women at the turn of the fifth and sixth decade of life. In those aged 45–64, 60% of males and 52% of females will be diagnosed with head and neck cancers. Younger people, males aged 5–44 and females aged 10–29, are most at risk of external causes such as accidents (traffic, falls, poisonings, drownings), suicides, and crime. In old age, men are most threatened by diseases of the circulatory system and, to a slightly lesser extent, cancer.

In 2021, those over 80 years of age were most at risk of dying from COVID-19, while for women 30–74 years the highest risk was by malignant tumors in general, which are replaced by circulatory system diseases only in the oldest age. After cancer, COVID-19 was the second most common cause of death in women aged 35–64. Of the 36 types of cancer listed, 8 concern the head and neck [5]. Worldwide, almost half of all cases (49.2%) and most (56.1%) cancer deaths in 2022 occurred in Asia, where 59.2% of the world's population lives.

Based on projected changes in population growth and aging, and assuming overall cancer rates remain unchanged, more than 35 million new cases of cancer are projected to occur in 2050, a 77% increase from the 20 million cases estimated for 2022.

The coronavirus disease pandemic caused over 6 million deaths between 2020 and 2022 and has severely impacted healthcare systems around the world. Many cancer registries around the world reported disruptions in their operations during the first wave of the pandemic [6]. The subsequent impact on cancer rates may be moderate and short-term. Several registries reported [7–9] that the receipt of relatively fewer pathology reports in the earlier months was compensated by increased diagnostic activity in the later months.

Conclusions

1. Compared to the data from the Polish National Cancer Registry from 2000, both the incidence and death rates of malignant tumors of the nasal cavity and middle ear increased in 2022, as did other head and neck cancers.

2. Malignant tumor of the nasal cavity and middle ear (ICD-C30) is the 20th most common cancer of the head and neck.

3. The Polish National Cancer Registry from 2022 shows that malignant tumor of the nasal cavity and middle ear (ICD-C30) is the 19^{th} most common cancer of the head and neck in terms of deaths, along with malignant tumor of the gums (ICD-C03).

4. The most common head and neck cancer based on the 2022 Polish National Cancer Registry in terms of incidence is thyroid cancer (ICD-C73), and in terms of deaths, laryngeal cancer (ICD-C32).

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Conflict of Interest

The authors declare no conflicts of interest.

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TOWARD BETTER COMMUNICATION FOR PATIENTS WITH HEARING IMPAIRMENT IN COMMUNITY PHARMACIES: RESULTS OF A QUESTIONNAIRE

Contributions:
A Study design/planning
B Data collection/entry
C Data analysis/statistics
D Data interpretation
E Preparation of manuscript
F Literature analysis/search
G Funds collection

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Abstract

Introduction: People with hearing impairment may experience communication barriers in healthcare, which can reduce understanding of medication instructions and compromise patient safety. Community pharmacies are highly accessible, yet routine verbal counseling may be insufficient for patients with hearing impairment.

Aim: To assess communication experiences of patients with hearing impairment in community pharmacies, including perceived communication quality, understanding of pharmacist-provided information, availability of communication aids, and perceived accessibility of support options.

Material and methods: We conducted an anonymous, paper-based cross-sectional survey among adults with hearing impairment ($N = 41$) between March and May 2025. The 17-item questionnaire was developed from the literature and refined through expert review and patient feedback for clarity and face validity. Participants were recruited by community pharmacists using convenience sampling. Descriptive statistics are reported as n [%]. Associations were tested using chi-square or Fisher's exact tests with Cramér's V. Ordinal logistic regression explored factors associated with reported understanding and accessibility practices.

Results: Pharmacists' communication skills were rated high/very high by 56.1% ($n = 23$). However, 51.2% ($n = 21$) reported that pharmacists did not use communication aids adapted to hearing-impaired patients, and medication information was not fully adapted in 78.0% ($n = 32$). Communication difficulties were experienced at least occasionally by 46.3% ($n = 19$). Although 75.6% ($n = 31$) had the opportunity to ask additional questions, only 2.4% ($n = 1$) reported being asked about a preferred communication method. Sign language support was rarely available (92.7% never met a pharmacist able to use sign language; $n = 38$). Greater adaptation of medication-related information was associated with clearer instructions (adjusted OR = 3.47, 95% CI 1.14–10.62; $p = 0.029$), and greater use of communication aids was associated with better understanding of pharmacist-provided information (adjusted OR = 12.24, 95% CI 1.99–75.49; $p = 0.007$).

Conclusions: Despite generally positive ratings of pharmacists' communication skills, important accessibility gaps persist in community pharmacies. Routine use of written/visual aids, asking about preferred communication methods, and teach-back to confirm understanding may improve inclusive, patient-centered counseling for people with hearing impairment.

Keywords: hearing loss • community pharmacy • accessibility • pharmacist–patient communication • medication counseling

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W KIERUNKU LEPSZEJ KOMUNIKACJI Z PACJENTAMI Z NIEDOSŁUCHEM W APTEKACH LOKALNYCH: WYNIKI ANKIETY

Streszczenie

Wprowadzenie: Osoby z niedosłuchem (różnego stopnia) mogą doświadczać barier komunikacyjnych w opiece zdrowotnej, co może ograniczać zrozumienie zaleceń dotyczących stosowania leków. Apteki są palcówkami z reguły łatwo dostępnymi dla pacjentów, jednak dla pacjentów z niedosłuchem rutynowo stosowana komunikacja werbalna może być niewystarczająca.

Cel: Celem badania była ocena doświadczeń komunikacyjnych pacjentów z niedosłuchem w aptekach ogólnodostępnych, w tym postrzeganej jakości komunikacji, zrozumienia informacji przekazywanych przez farmaceutów oraz dostępności pomocy komunikacyjnych.

Materiał i metody: Anonimowe badanie zostało przeprowadzone wśród dorosłych osób z niedosłuchem ($N = 41$) w okresie od marca do maja 2025 roku. Kwestionariusz zawierał 17 pytań i opracowano go na podstawie literatury, a następnie dopracowano po ocenie eksperckiej oraz po otrzymaniu informacji zwrotnych od pacjentów w celu poprawy jasności i trafności pytań. Uczestników rekrutowali farmaceuci pracujący w aptekach ogólnodostępnych. Statystyki opisowe przedstawiono jako [%].

Wyniki: Umiejętności komunikacyjne farmaceutów zostały ocenione jako wysokie lub bardzo wysokie przez 56,1% respondentów ($n = 23$). Jednocześnie 51,2% badanych ($n = 21$) zgłosiło, że farmaceuci nie stosowali pomocy komunikacyjnych dostosowanych do pacjentów z niedosłuchem, a informacje dotyczące leków nie były w pełni dostosowane w przypadku 78,0% respondentów ($n = 32$). Zdecydowana większość respondentów – 75,6% ($n = 31$) – miała możliwość zadawania dodatkowych pytań, jednak tylko 2,4% ($n = 1$) wskazało, że zapytano ich o preferowaną metodę komunikacji. Wsparcie w języku migowym było rzadko dostępne – 92,7% badanych nigdy nie spotkało farmaceuty potrafiącego posługiwać się językiem migowym ($n = 38$). Większe dostosowanie do potrzeb odbiorcy informacji na temat leków sprawiało, że instrukcje były jaśniejsze, a efektem stosowania pomocy komunikacyjnych było lepsze zrozumienie informacji przekazywanych przez farmaceutę.

Wnioski: Pomimo ogólnie pozytywnych ocen odnośnie umiejętności komunikacyjnych farmaceutów, w aptekach ogólnodostępnych nadal występują istotne luki w zakresie dostępności. Rutynowe stosowanie form komunikacji niewerbalnej (informacji pisemnych i wizualnych) oraz pytanie pacjentów o preferowane metody komunikacji w celu potwierdzenia zrozumienia informacji mogą poprawić jakość konsultacji farmaceutycznych w przypadku osób z niedosłuchem.

Słowa kluczowe: niedosłuch • apteka lokalna • dostępność • komunikacja farmaceuta–pacjent • poradnictwo farmaceutyczne

Introduction

Hearing loss is a prevalent condition that can affect communication, access to healthcare, and treatment outcomes, and its global burden is increasing, especially in older adults [1,2]. Communication barriers in healthcare settings may lead to misunderstanding of recommendations, reduced adherence, and increased risk of medication-related problems and errors [3,4]. These issues are particularly important in community pharmacies, where pharmacists play a key role in patient education and medication safety.

Community pharmacies are among the most accessible healthcare facilities. However, routine verbal counseling may be insufficient for patients with hearing impairment, especially in noisy environments or when patients rely on hearing aids, cochlear implants, lip-reading, or written communication. Communication support tools (e.g., written instructions, pictograms, graphic aids, and teach-back techniques) may improve the clarity of counseling and reduce the risk of medication-related problems [5–8]. Evaluating patient-reported experiences can identify gaps in accessibility and support improvements in patient-centered pharmaceutical care for hearing-impaired individuals.

The aim of this study was to assess communication experiences of patients with hearing impairment in community pharmacies, including perceived communication quality, understanding of pharmacist-provided information, availability of communication aids, and perceived accessibility of support options.

Material and methods

Ethics approval was obtained from the Bioethics Committee (IFPS: KB/Statement No. 2/2025). We conducted a non-invasive, anonymous, paper-based, cross-sectional survey for patients who suffered from hearing impairment and/or were users of hearing aids and/or hearing implants. Patients fill in a questionnaire when they visited participating community pharmacies. The questionnaires were distributed and collected by pharmacists. Data was collected between March and April 2025.

The 17-item questionnaire was developed specifically for this study based on a literature review on communication barriers in pharmacy services for hearing-impaired individuals. Items covered: (1) perceived quality of pharmacist communication, (2) comprehension of counseling and medication instructions, (3) availability of communication support tools, and (4) pharmacy-level accessibility and service improvement needs. Ordinal response options were used to minimize respondent burden and facilitate completion in routine pharmacy settings (estimated completion time 5–7 minutes). The draft instrument underwent expert review and patient feedback to assess clarity and face validity, and minor wording refinements were made before field use. In the end, 41 patients filled in the questionnaire.

Statistical analysis

Descriptive statistics were summarized as counts (n) and percentages (%). For multiple-choice questions, results were reported as the number of selections. Inferential analyses were conducted in a hypothesis-driven manner, based on predefined research questions concerning the relationship between communication accessibility practices and patient-reported outcomes. Specifically, we examined whether (i) the use of communication aids was associated with better understanding of pharmacist-provided information, and (ii) the adaptation of medication-related information was associated with clearer medication instructions. The models included understanding of pharmacist-provided information (Q4) and clarity of medication instructions (Q11) as outcome variables, with communication aids (Q3) and adaptation of medication information (Q8) as main predictors, respectively. All models were adjusted for age group. Results are presented as odds ratios (ORs) with 95% confidence intervals (CIs). Secondary, exploratory analyses were conducted to assess associations between selected categorical variables using the chi-square test of independence or Fisher's exact test when cell counts were <5. Effect sizes were reported using Cramér's V. Internal consistency of the 6-item communication accessibility scale (Q3, Q4, Q5, Q8, Q10, Q11; coded 0–2) was assessed using Cronbach's alpha.

Table 1. Participant profiles and pharmacy use ($n = 41$)

Characteristic	*n*	[%]
Age 18–44 years	18	44
Age 45–59 years	9	22
Age 60–74 years	7	17
Age 75–79 years	6	15
Age >80 years	1	2
Hearing aid user ($n = 38$): Yes	17	45
Hearing aid user ($n = 38$): No	21	55
Hearing implant user ($n = 35$): Yes	12	34
Hearing implant user ($n = 35$): No	23	66
Pharmacy visit: once a week	10	24
Pharmacy visit: once a month	22	54
Pharmacy visit: less often	9	22

Note: Numbers differ for hearing aid ($n = 38$) and hearing implant ($n = 35$) users due to missing responses

A p-value <0.05 was considered statistically significant. Analyses were performed using Statistica v. 13.3.

Results

Participants

Most respondents reported visiting a community pharmacy once a month (54%, $n = 22$) or once a week (24%, $n = 10$) (**Table 1**).

Pharmacists' communication skills were rated as high or very high by 56% of participants ($n = 23$). However, 46% ($n = 19$) reported experiencing communication difficulties at least occasionally, indicating that positive interpersonal ratings do not necessarily reflect fully accessible communication.

More than half of respondents (51%, $n = 21$) reported that pharmacists did not use communication aids adapted to hearing-impaired patients. Medication-related information was not fully adapted in 78% of cases (no/partly yes; $n = 32$). Although 76% ($n = 31$) of participants declared that they had the opportunity to ask additional questions, only 2% ($n = 1$) reported being asked about their preferred communication method. Sign language communication was rarely available, with 93% ($n = 38$) reporting no access (**Table 2, Figure 1**).

Available communication forms and suggested improvements

The most commonly available communication support was written material (brochures; 74%). Other solutions, such as pictograms, induction loop systems, and digital tools, were infrequently reported. Participants most frequently indicated that additional pharmacist training (29%) and communication-supporting technologies (28%) were needed to improve accessibility (**Table 3**).

Greater adaptation of medication-related information (Q8) was significantly associated with clearer and more understandable medication instructions (Q11) in an ordinal logistic regression adjusted for age group (OR = 3.47, 95% CI: 1.14–10.62; $p = 0.029$).

Similarly, greater use of communication aids (Q3) was significantly associated with better understanding of pharmacist-provided information (Q4) (OR = 12.24, 95% CI: 1.99–75.49; $p = 0.007$) (**Table 4**).

Secondary exploratory analyses examining associations between selected variables and communication difficulties did not demonstrate consistent statistically significant relationships.

Discussion

Communication accessibility remains a critical yet underaddressed component of pharmaceutical care for hearing-impaired individuals. While community pharmacists are often the most accessible healthcare professionals, effective counseling requires not only interpersonal competence but also structured strategies that ensure information is delivered in an accessible format and understood by the patient. In our study, respondents generally rated pharmacists' communication skills positively; however, the results simultaneously reveal substantial accessibility gaps in routine community pharmacy counseling. This discrepancy suggests that patients may perceive pharmacists as polite, engaged, or helpful, while still experiencing structural barriers that limit the accessibility and safety of medication-related communication. Similar challenges have been described in qualitative work among hospital pharmacists, who reported uncertainty regarding optimal communication approaches and emphasized the need for structured tools and training to support interactions with hearing-impaired patients [9]. A pharmacist-focused needs assessment likewise demonstrated gaps in communication competencies and highlighted the importance of targeted education to improve patient-centered care for hearing-impaired individuals [10].

Table 2. Communication experience and accessibility support in community pharmacies ($n = 41$)

Question	No [%]		Sometimes yes [%]		Yes [%]
Q3. Communication aids used	51.2		36.6		12.2
Q4. Understand pharmacist information	7.3		31.7		61.0
Q5. Opportunity to ask questions	2.4		22.0		75.6
Q8. Medication information adapted	24.4		53.6		22.0
Q9. Information about support options	61.0		21.9		17.1
Q10. Asked about preferred method	73.2		24.4		2.4
Q11. Clear medication instructions	7.3		34.1		58.5
Q12. Sign language available	92.7		4.9		2.4
	Very low [%]	**Low [%]**	**Average [%]**	**High [%]**	**Very high [%]**
Q2. Communication skills	2.4	7.3	34.1	41.5	14.6
	Very often [%]	**Often [%]**	**Occasionally [%]**	**Rarely [%]**	**Never [%]**
Q7. Communication difficulties	7.3	22.0	17.1	39.0	14.6
	No [%]		**Partly yes [%]**		**Yes [%]**
Q16. Understanding patient needs	20.0		45.0		35.0

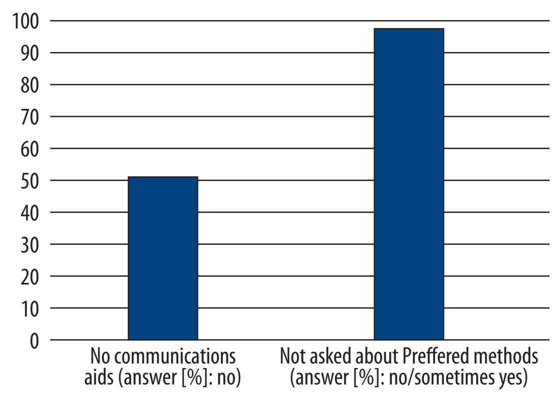

Figure 1. Key communication accessibility gaps reported by participants

Our findings align with and extend community pharmacy evidence indicating that hearing-impaired individuals experience unmet needs and barriers when accessing pharmacy services, including limitations in counseling quality, privacy, and accessible delivery of information [5]. In our study, communication aids such as written notes, pictograms, or graphic support were not routinely implemented, and medication information was frequently only partially adapted to the needs of hearing-impaired patients. Importantly, these accessibility gaps were not merely descriptive: our analyses demonstrated that accessibility-related practices were meaningfully associated with patient-reported outcomes. The greater use of communication aids, the better understanding of pharmacist-provided information, and the better adaptation of medication information was associated with clearer medication instructions. These findings provide quantitative support for conceptualizing accessible communication strategies as quality indicators of pharmaceutical care rather than optional additions to counseling. This is consistent with prospective observations from community pharmacy settings showing that communication adaptation remains an important and often insufficiently addressed component of pharmaceutical counseling for hearing-impaired patients [11].

From a patient safety perspective, communication barriers may increase the likelihood of medication-related problems, particularly when counseling relies heavily on verbal instructions delivered in time-limited and potentially noisy environments. For hearing-impaired patients, insufficient adaptation of information may translate into misunderstanding of dosing regimens, missed contraindications, or failure to recognize key safety warnings. A systematic review and meta-analysis of communication between healthcare professionals and patients with hearing loss emphasized that communication barriers are common and can negatively affect patient understanding and care outcomes, reinforcing the need for structured approaches to improve accessibility [3]. This concern is further supported by broader evidence that individuals with sensory impairment face barriers to safe and effective medication use, including challenges in receiving and interpreting medicine-related information [4]. In addition, the global burden of hearing loss continues to increase, particularly in older adults, making communication accessibility in frontline healthcare services increasingly relevant [1,2].

A notable and clinically relevant finding in our study was the limited availability of sign language communication in community pharmacies. Most respondents reported that sign language support was not available, which significantly restricts access to counseling for patients who rely on sign language as their preferred method of communication. At the same time, pharmacists rarely ask patients about their preferred communication method, indicating limited personalization of counseling. This is an important service design gap according to other authors too [7]. Similarly, studies exploring barriers and facilitators in community pharmacy settings have described

Table 3. Multiple-choice items: available communication forms and suggested improvements (multiple selections)

Question	Answer	[%]
Q6. Available communication forms	Brochures	74.5
	Induction loop stations	10.6
	Pictograms	6.4
	Information displays	4.3
	Mobile applications	2.1
	Other	2.1
Q13. Suggested improvements	Additional training	28.8
	Mobile applications	27.5
	Graphic materials	16.3
	Sign language knowledge	11.3
	Induction loops	11.3
	Pictograms	5.0

Table 4. Hypothesis inferential analyses

Hypothesis	Model/Test	Result	*p*-value
Communication aids and understanding	Q3 → Q4 (adjusted for age)	OR = 12.24 (95% CI 1.99–75.49)	0.007
Adapted information and clarity	Q8 → Q11 (adjusted for age)	OR = 3.47 (95% CI 1.14–10.62)	0.029

environmental and workflow-related obstacles, including time pressure, lack of training, and limited access to tailored communication tools [6]. The results of our study suggest that low-cost, scalable interventions could be prioritized to improve accessibility without requiring extensive structural changes. Additionally, pharmacies may implement standardized prompts in workflow (e.g., "Do you prefer written or oral communication?") and provide visible information about available support options (e.g., written counseling, quiet consultation areas, communication cards). Such approaches are consistent with patient-centered care principles and align with calls for targeted training and structured communication support identified in pharmacist-focused studies [9,10]. Moreover, digital communication supports – including mobile applications, electronic written instructions, or pharmacy-based visual displays – may offer feasible solutions, particularly when staff are not proficient in sign language [6,10].

Several limitations should be acknowledged. First, the study was conducted in a relatively small sample ($n = 41$), which may limit generalizability and reduce statistical power to detect associations, particularly in subgroup analyses. Second, the questionnaire-based design may be subject to self-report bias, and some response categories included low counts, requiring Fisher's exact testing in selected analyses. Additionally, several items demonstrated floor or ceiling effects (e.g., sign language availability), which may limit variability and reduce the ability to detect subgroup differences. Despite these limitations, this study provides actionable patient-reported evidence that highlights specific gaps in community pharmacy communication accessibility and identifies practical strategies for service improvement. Future multi-site studies with larger and more diverse samples are needed to validate these findings, evaluate structured interventions, and support the development of standardized measures for communication accessibility in pharmacy practice.

Conclusions

Despite generally positive ratings of pharmacists' communication skills, important accessibility gaps remain in community pharmacy counseling for hearing-impaired patients: communication aids and medication information adapted to patients' needs are not routinely provided, sign language communication is rarely available, and pharmacists seldom ask patients about their preferred communication method. These findings suggest that improving the standardized use of written/visual aids and structured communication support may enhance medication safety and patient-centered pharmaceutical care.

Declaration

The authors declare no conflict of interest. The data supporting the findings of this study are available from the corresponding author upon reasonable request.

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Conference reports

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REPORT ON THE 2nd ELETROESCUTA EXPERIENCE, SÃO PAULO, BRAZIL

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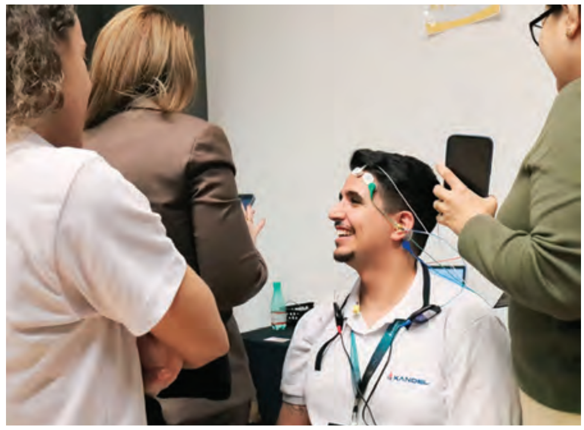
Between June 27 and 28, 2025, the 2nd EletroEscuta SP Experience was held in the city of São Paulo, bringing together more than 150 people interested in deepening their knowledge of auditory electrophysiology. The focus of the event was on clinical challenges and complex cases in the field of electrophysiology. The scientific coordinators were Prof. Dr. Milaine Dominici Sanfins and Prof. Dr. Daniela Gil, while the technical coordinators were biomedical engineers Maria Eduarda Aidar Santillo and Luísa Vitória Leite Oliveira.

The EletroEscuta SP Experience aims to advance knowledge in electrophysiology, neuroscience, electroacoustics, and audiology, with a strong emphasis on the exchange of knowledge between academics and practitioners, fostering collaborative learning and shared development.

The speakers included Prof. Dr. Carla Gentile Matas, Dr. Daniela Capra, Prof. Dr. Daniela Gil, Dr. Gabriela Ivo, Prof. Dr. Lais Ferreira, Dr. Luciane Pauletti, Prof. Dr. Maria Francisca Colella-Santos, Prof. Dr. Michele Vargas Garcia, Prof. Dr. Milaine Dominici Sanfins, Dr. Roberto Beck, Dr. Tiago Silva, and Dr. Tobias Torres.

Prof. Dr. Milaine Sanfins – scientific coordinator of the EletroEscuta SP Experience


EletroEscuta attendees during the practical class on Auditory Evoked Potentials

The topics of the theoretical classes were chosen for maximum enjoyment and learning. Some of the topics discussed were:

- *Hearing and genetics* – the most common etiologies of sensorineural hearing loss and updates on gene therapy research;
- *Traumatic brain injury* – what does electrophysiology reveal about the injured brain?
- *The deep-end of electrophysiology* – what do we really need to know about masking?
- *Exploring the frontiers of electrophysiological assessment of hearing* – click-evoked auditory brainstem responses, specific frequency ABR, and steady-state auditory evoked potentials;
- *Electrophysiology in special populations* – particular challenges in the assessment of children, the elderly, and patients with cognitive disabilities;
- *How can electrophysiology be used to assess and monitor speech disorders?*
- *Cochlear implants and electrophysiology* – uncovering new frontiers and mastering best practices;
- *Electrophysiological evaluation and its role in the differential diagnosis of tinnitus*;
- *Vestibular assessment and rehabilitation* – are you using electrophysiology's full potential?
- *Cognitive auditory evoked potentials (P300)* – controversies and discussions. What is the future of cognitive auditory assessment?

Speakers and conference attendees during the coffee break

At the end of the theoretical presentations, there was a discussion of cases. The theme was electrophysiology – integrating theory and practice. For the practical activities, several workstations were set up, equipped with equipment for attendees to handle. Each workstation was staffed by a professional electrophysiologist and a technician. The professionals included Bruna de Medeiros Giacomel, Carla Gentile Matas, Carolina Henrique Lustosa, Caroline Donadon, Daniela Gil, Daniela Capra, Lais Ferreira, Luciane Pauletti, Maria Francisca Colella-Santos, Michele Vargas Garcia, Milaine Dominici Sanfins, Patrícia Guerra, Thais Diniz, and Thiago Silva. So that everyone could take full advantage of the practical sessions, a lecture beforehand focused on technical mastery and how to minimise technical problems.

The 3rd Eletroescuta Experience SP will take place from 4th to 6th June 2026, at the Tivoli Mofarrej hotel in São Paulo, and will be expanded to include auditory processing, otoneurology, and tinnitus.

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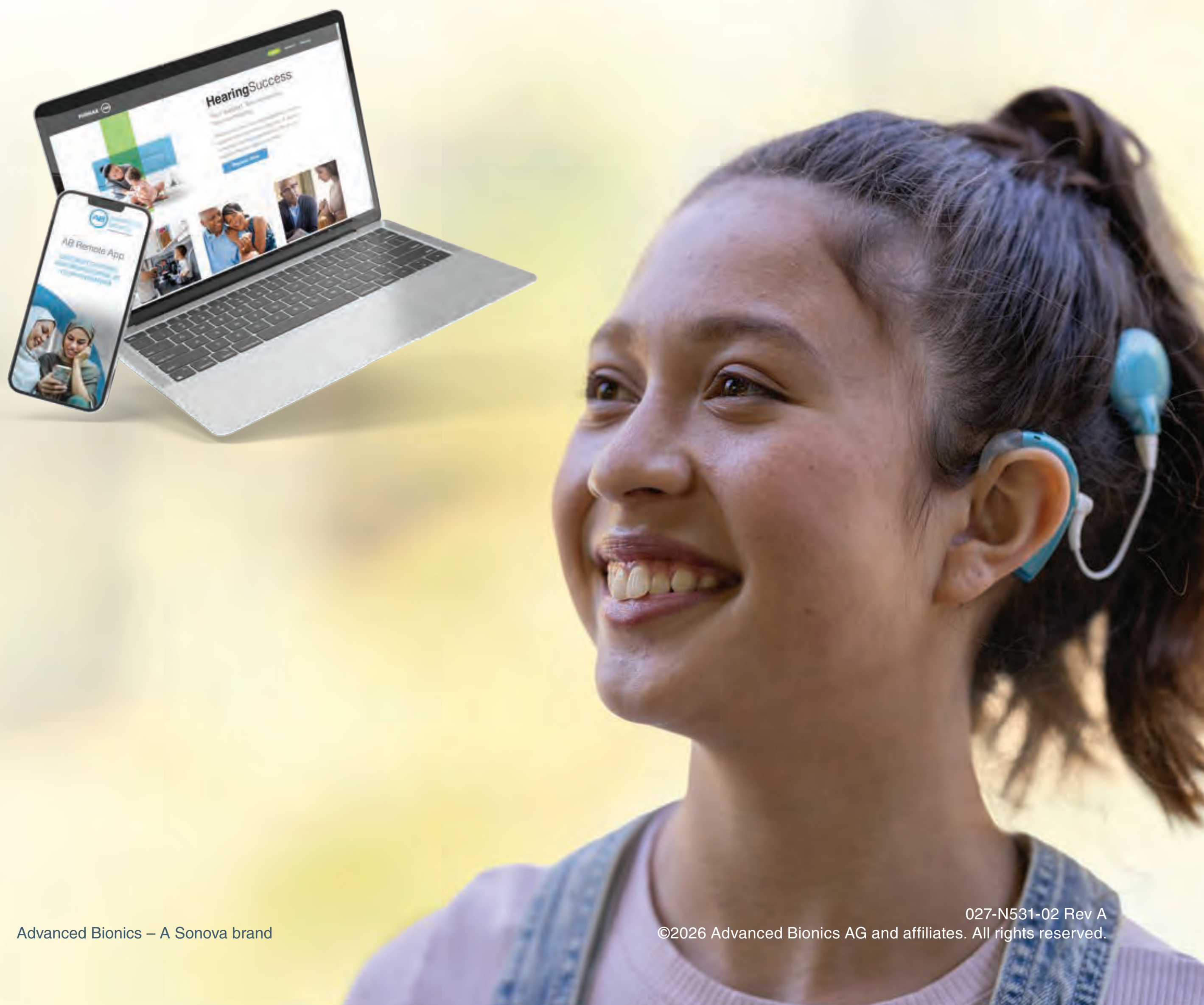

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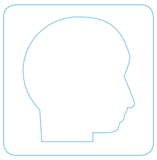

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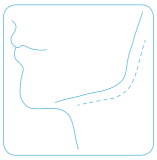

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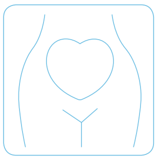

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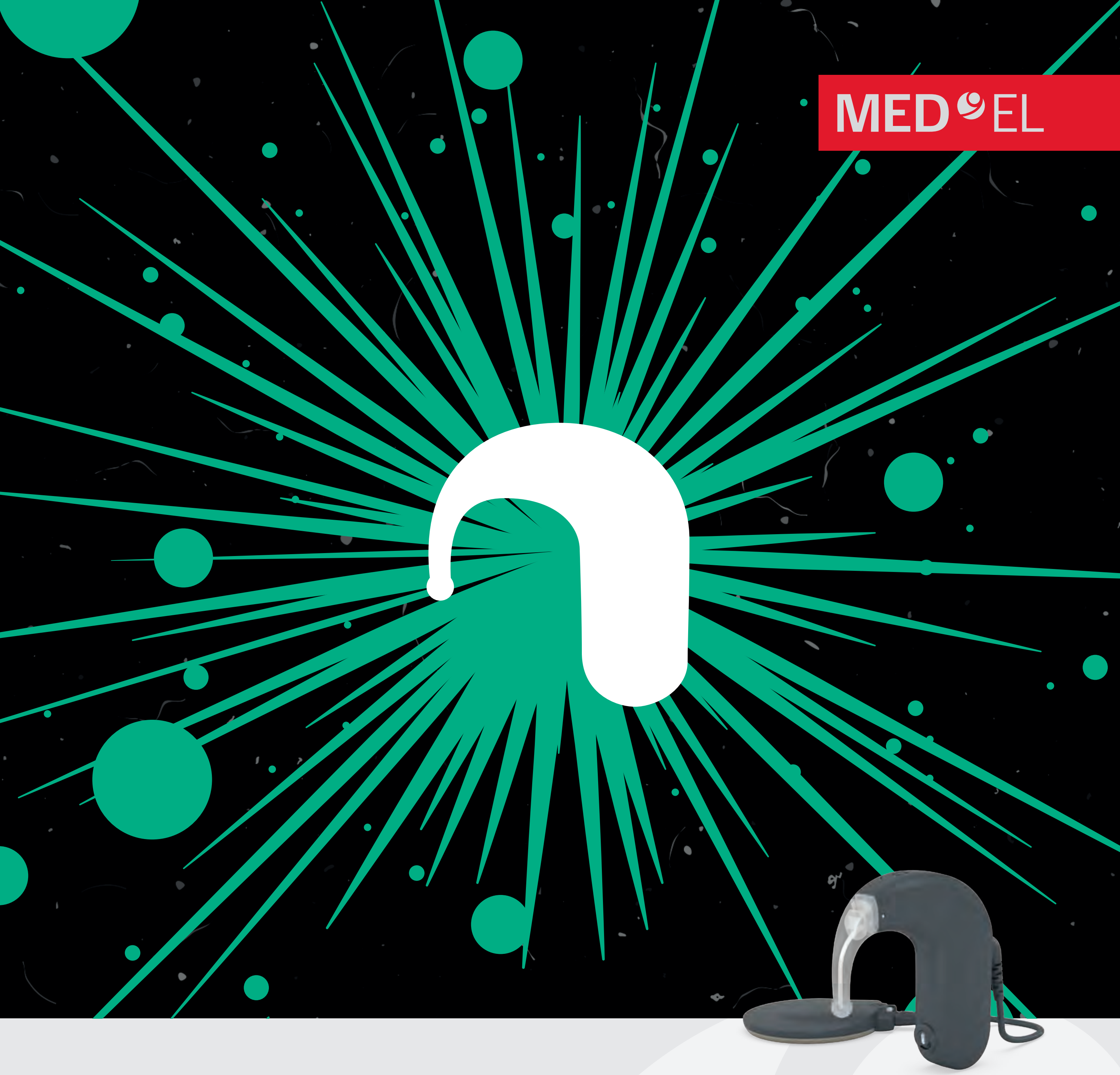

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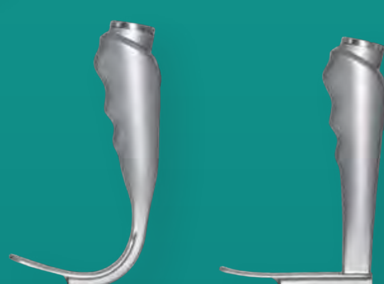

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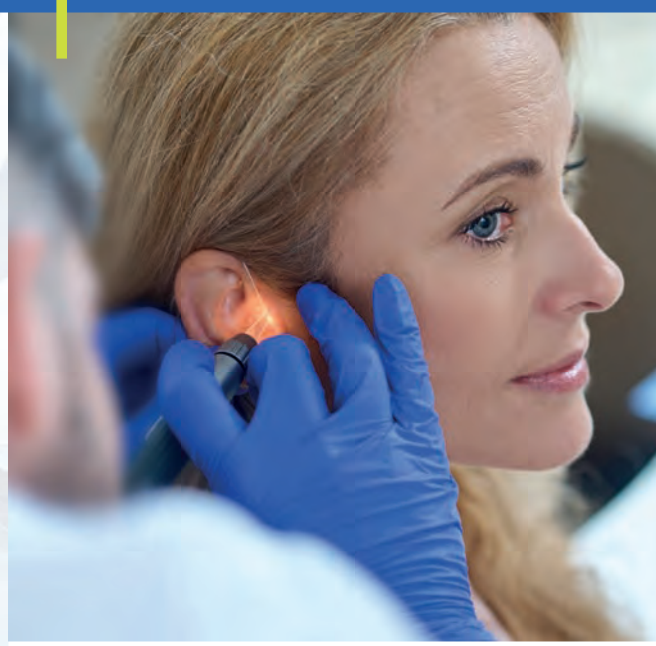

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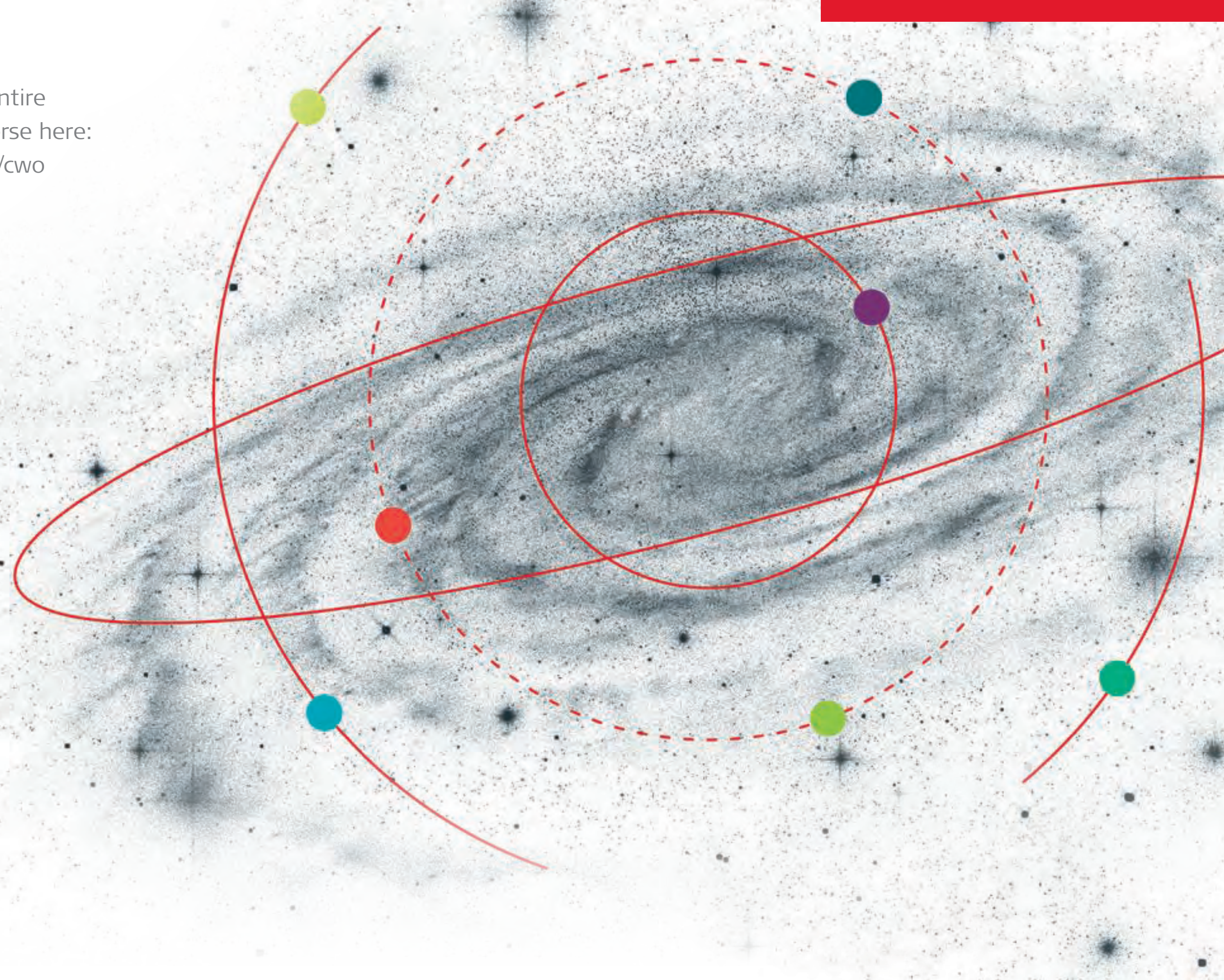

The Institute, founded in 2008, develops diagnostics, treatment, and preventive measures for sensory organs and implements innovative medical solutions.

Our achievements and activities include:

- co-developing the Platform of Sensory Organs Examination and the Stimulation of Polymodal Sensory Perception (SPPS-S),
- co-organising international training courses and workshops, including the Window Approach Workshops (WAW) and the International Course on Endoscopic Sinus Surgery,
- co-organising national and international conferences and congresses,
- co-organising the prestigious Congress “Health of Poles”,
- co-organising the Congress “Science for the Society”.

We also collaborate in publishing:

- Journal of Hearing Science – a quarterly journal published in English (od 2011 r.)
- Nowa Audiofonologia (New Audiophonology) – a quarterly journal published in Polish (since 2012),
- Słyszę (I can hear) – a popular science bimonthly magazine for people with hearing and speech disorders (since 1997).

The Institute of Sensory Organs is a place where science, innovation, and clinical practice come together for the benefit of patients and the progress and development of medicine.

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Journal of Hearing Science®

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WORLD HEARING CENTER

The World Hearing Center is a modern specialized hospital providing medical care at the highest quality level in the fields of otolaryngology, audiology, phoniatrics, rehabilitation and biomedical engineering. It is superbly equipped for research and education, and includes modern conference facilities. The Center conducts a wide range of research and educational activities addressed to specialists from Poland and other countries. The Center is one of the leading medical institutions in the field of hearing disorders treatment, running, among others, one of the largest hearing implant programs in the world and performing 15,000 to 21,000 surgical procedures yearly.

The Center provides its patients with comprehensive diagnostics, conservative treatments, and surgery for the rehabilitation of:

- congenital and acquired malformations of the external, middle and inner ear,
- hearing, speech and balance disorders of different etiologies,
- disorders of the mouth cavity, throat and larynx, disorders of the nose and paranasal sinuses, sleep disorders.

World Hearing Center:

- is a global leader in terms of the number of performed otorhinolaryngological surgeries and the number of outpatient consultations (more than 200,000 consultations per year),
- is the place where unique and highly specialized medical procedures are performed, including reconstruction surgeries of congenital defects of the outer ear, treatment of profound and partial deafness with various hearing implants, phonosurgeries, endoscopic sinus surgeries under image guidance, and many others,
- employs a team of highly qualified and experienced specialists,
- has state-of-the-art medical equipment and instrumentation,
- offers comfortable conditions for hospital stays,
- uses the most modern telemedical solutions providing of Teleaudiology.

The team of the Institute of Physiology and Pathology of Hearing and its individual employees are winners of numerous international and national awards.

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