

Attitude Change of Hearing Health Professionals on Bone-Anchored Hearing Devices Over Time in a Developing Country

ABSTRACT

Background: Bone-anchored hearing instruments (BAHIs) are an important alternative solution for hearing loss in a particular group of patients. This study aims to examine shifts in attitudes about BAHIs among hearing health professionals over time.

Methods: A survey was designed to assess the knowledge and attitude of otorhinolaryngologists (ENT) and audiologists (Au) concerning BAHIs. The survey was administered in 2019 and 2023 at various conferences.

Results: The survey received 243 responses (122 in 2019 and 121 in 2023). Among these, 186 (77%) were from ENTs, while 49 (20%) were from Aus. Notably, the preference for using BAHl for conductive and mixed hearing loss cases increased from 19.3% to 47.9%. The number of individuals with prior experience decreased, yet those who applied BAHIs grew. Significant shifts were observed in patient selection based on hearing level, hearing loss type, and clinical condition. The profession and experience emerged as influential factors in these changes.

Conclusion: While most subjects recognized the significance of hearing rehabilitation, their fundamental knowledge and familiarity with BAHIs remained limited. A broader implementation of educational and training initiatives focusing on BAHIs is essential to enhance understanding and proficiency in this area.

Keywords: Bone-anchored hearing aid, hearing rehabilitation, hearing aid, awareness

INTRODUCTION

Hearing loss has emerged as a significant health concern in the present day. According to the 2017 World Health Organization reports, approximately 466 million individuals worldwide suffer from moderate-to-severe bilateral hearing loss, two-thirds residing in developing nations.¹ If left untreated, hearing loss can lead to various critical issues, including a diminished quality of life, impaired social interactions, and a loss of independence.² Additionally, it can give rise to secondary problems like learning disabilities, depression, unemployment, and reduced self-esteem.³

Traditionally, behind-the-ear hearing aids (BTE-HA) have been the primary choice for hearing loss rehabilitation. However, bone-anchored hearing instruments (BAHIs) offer robust rehabilitation solutions for conductive and mixed-type hearing loss caused by outer and middle-ear pathologies like aural atresia and chronic otitis media, especially in cases where BTE-HAs are not available or inadequate.^{4,5} To ensure the effective embrace of this alternative hearing restoration approach, healthcare professionals must furnish accurate and timely information to their patients. Thus, a solid understanding of the subject and vigilance toward advancements becomes imperative. Numerous activities are arranged through conferences and courses dedicated to this subject matter.

This study aims to monitor the changes in the awareness of healthcare professionals about the subject by comparing surveys done 4 years apart.



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MATERIAL AND METHODS

The research adhered to the ethical guidelines outlined in the "Declaration of Helsinki" and received approval from the Recep Tayyip Erdogan University ethics committee (2019/94, date: 02.10.2019). The target health professionals for the cohort were otolaryngologists (ENT) and audiologists (Aus). All participants read and approved an informed consent. For the first survey in 2019, following preliminary interviews, key aspects were identified, leading to the development of a user-friendly questionnaire. The participants were asked about their demographic information, professional characteristics, approach to hearing rehabilitation, and awareness of health insurance coverage regarding BAHIs. In our country, health insurance covers the cost of BAHl, including surgical fees, as long as the patients meet the specified requirements. The 14 questions thoroughly examined the participants' knowledge levels of these conditions and their indication preferences related to BAHIs. The questionnaire was distributed to participants during relevant congresses of both groups. Consequently, participation was secured from nearly all country regions, representing medical institutions at different levels. The study includes all completed questionnaires.

In 2023, the same questionnaire was applied to randomly selected cohorts by the same channels.

Statistical analyses were performed using the Statistical Package for Social Sciences 16.0 (SPSS Inc.; Chicago, IL, USA) program. The results were compared with Pearson's chi-square test. The significance level was accepted as $P < .05$.

RESULTS

In 2019, 122 participants completed the survey, while in 2023, 121 participants completed it. Demographic data and questionnaire outcomes are presented in Table 1. Among demographic features, only gender distribution displayed statistically significant variance between the 2 groups. In the initial group, 4 participants held dual roles as ENT and Au; these instances were excluded

MAIN POINTS

- This study aims to monitor the changes in the awareness of healthcare professionals about the subject by comparing surveys done 4 years apart.
- The inclination to choose bone-anchored hearing instruments (BAHI) over behind-the-ear hearing aids in cases of conductive or mixed hearing loss increased significantly over time, while the total number of experienced individuals using BAHIs declined.
- Conversely, the count of subjects utilizing BAHIs demonstrated an upward trajectory.
- These trends were notably influenced by professional background (audiologists or otolaryngologists) and the duration of professional experience.
- To initiate national and international educational campaigns tailored to carefully selected target groups is important

during ENT-Au comparisons. Additionally, distinct analyses were conducted for ENT and Au to assess attitude changes over time. (Tables 2 and 3)

Over the observed period, the practice of monitoring patients employing BTE-HAs exhibited a decline ($P = .001$). This trend was more pronounced among younger generations with 0-5 years ($P = .001$) and 5-10 years ($P = .013$) of experience. In contrast, professionals with 10-15 years of experience demonstrated a rise in the follow-up ratio from 38% to 89% ($P = .05$). The decrease in follow-up was significant for Aus ($P = .001$), while ENTs maintained a consistent ratio (Tables 2 and 3).

Notably, the inclination toward BAHIs over BTE-HAs in cases of conductive or mixed hearing loss significantly increased over time ($P = .001$) (Figure 1). This shift was primarily driven by ENTs ($P = .001$) and the younger generation with 0-5 years ($P = .001$) and 5-10 years ($P = .021$) of experience.

While the overall number of experienced individuals using BAHIs (both ENT and Au) diminished, the count of ENTs applying BAHIs expanded ($P = .001$). This transformation was particularly conspicuous within the 5-10 years experienced group ($P = .002$).

No substantial change was observed regarding awareness of reimbursement conditions for BAHIs ($P = .845$). Aus exhibited superior awareness compared to ENTs in 2019 ($P = 0.004$), but this distinction diminished by 2023 ($P = .396$).

The preferred type of hearing loss (conductive, sensorineural, mixed) remained unchanged overall. However, there were notable shifts in mild ($P = .008$) and profound ($P = .003$) hearing loss preferences. Aus favored mild hearing loss more than ENTs in 2019 ($P = .002$) and 2023 ($P = .001$). The increase in mild hearing loss preference primarily stemmed from the younger generation with 0-5 years of experience ($P = .031$), while a reduction in profound hearing loss preference was observed among experienced practitioners with 15+ years ($P = .036$).

A striking rise in using BAHIs for sequelae of chronic otitis ($P = .001$) and persistent external otitis ($P = .008$) over the years was evident (Figure 2). This increase was noticeable among Aus and ENTs, primarily within the younger generation with 0-5 years of experience ($P = .001$).

When investigating specific clinical conditions, a decrease in BAHl preference was noted for cases of mastoidectomy cavity infection ($P = .015$), issues related to improper molds due to cavity ($P = .017$), and insufficient amplification due to conductive hearing loss ($P = .042$).

DISCUSSION

Over 4 years, this study examined the evolution of awareness regarding BAHIs among healthcare professionals. The inclination toward choosing BAHl over BTE-HAs in cases of conductive or mixed hearing loss exhibited a significant increase over time, while the total number of experienced individuals using BAHIs declined. Conversely, the count of subjects utilizing BAHIs demonstrated an upward trajectory. These trends were notably influenced by professional background (Aus or ENTs) and the duration of professional experience.

Table 1. Comparison of 2 Cohorts

	2019	2023	P (2019-2023)
n	122	121	
F/M (n)	41/81	56/65	.044*
Audiologist/ENT/both (n)	21/97/4	28/89/0	.073
Primary/secondary/tertiary (n)	7/38/77	14/40/65	.186
Work experience in years 0-5/5-10/10-15/15< (n)	54/31/8/29	69/18/9/23	.112
The importance of hearing rehabilitation (1-10 scale) (median (minimum–maximum))	10 (5-10)	10 (1-10)	.615
Do you follow patients using BTE-HA? n (%)			
Yes	92 (75.4%)	65 (53.7%)	.001*
No	30 (24.6%)	56 (46.3%)	
Are hearing aids preferred for conductive or mixed hearing loss? n (%)			
BTE-HA	78 (65.5%)	46 (38.7%)	.001*
BAHI	23 (19.3%)	57 (47.9%)	
Both	18 (15.1%)	16 (13.4%)	
Experience in BAHIs n (%)			
None	3 (3%)	19 (16%)	.001*
Basic level	42 (35%)	38 (33%)	
I know, but I don't apply	58 (49%)	39 (33%)	
I am experienced, and I apply	16 (13%)	21 (18%)	
Level of awareness about reimbursement conditions for BAHIs n (%)			
No idea	43 (36%)	38 (33%)	.845
Have some idea	56 (47%)	58 (50%)	
Fully aware	21 (18%)	19 (17%)	
Which kind of hearing loss do you prefer, BAHI? n (%)			
Conductive hearing loss	91 (78%)	83 (72%)	.275
Mixed hearing loss	91 (78%)	87 (75%)	.618
Sensorineural hearing loss	33 (28%)	28 (24%)	.480
At what level of hearing loss do you prefer BAHI? n (%)			
Mild hearing loss	22 (19%)	39 (33%)	.011*
Moderate hearing loss	93 (83%)	86 (74%)	.281
Profound hearing loss	80 (68%)	58 (50%)	.003*
Total hearing loss	14 (12%)	12 (10%)	.677
Indications most preferred by the participants for BAHIs n (%)			
Aural atresia/stenosis	61 (55%)	50 (45%)	.160
Sequela of chronic otitis	20 (18%)	52 (47%)	.001*
Persistent external otitis	11 (10%)	26 (23%)	.006*
Mastoidectomy cavity	66 (59%)	56 (51%)	.227
In what conditions do you prefer BAHIs n (%)			
Frequent infection in mastoidectomy cavity	70 (60%)	54 (45%)	.022*
Improper mold due to cavity	79 (68%)	64 (54%)	.025*
Insufficient amplification due to CHL	88 (76%)	77 (65%)	.062
Frequent otitis externa due to hearing aids	56 (48%)	68 (57%)	.173
Sequelae chronic otitis became active after using BTE-HA	73 (63%)	69 (58%)	.438
Aural fullness and pressure due to BTE-HA	42 (36%)	36 (30%)	.332

Pearson's chi-square test.
BAHI, bone-anchored hearing instruments; BTE-HA, behind-the-ear hearing aids; CHL, conductive hearing loss.

Auditory rehabilitation, as defined by the American Speech–Language–Hearing Association, encompasses the treatment and education provided to individuals grappling with hearing loss.⁶ The foremost and pivotal step in rehabilitating

an individual's hearing loss is the accurate application of suitable treatment. Following essential surgical and medical interventions, the initial and fundamental stage of rehabilitation involves selecting an appropriate device capable of

Table 2. The Responses Were Compared According to Profession

	Audiologist	ENT	P (Au-ENT) 2019	P (Au-ENT) 2023
Do your patients use BTE-HA? (2019%-2023%)				
Yes	95%-29%	71%-61%	.023*	.001*
P (2019-2023)	.001*	.151		
Are hearing aids for conductive or mixed hearing loss? (2019%-2023%)				
BTE-HA	33%-25%	72%-43%	.003*	.05*
BAHI	38%-68%	16%-42%		
Both	29%-7%	12%-15%		
P (2019-2023)	.061	.001*		
Experience in BAHIs (2019%-2023%)				
None	0%-30%	3%-9%	.055	.064
Basic level	15%-26%	41%-36%		
I know, but I don't apply	60%-26%	46%-36%		
I am experienced, and I apply	25%-19%	10%-19%		
P (2019-2023)	.018*	.027*		
Level of awareness about reimbursement conditions for BAHIs (2019%-2023%)				
No idea	14%-42%	42%-30%	.004*	.396
Have some idea	48%-42%	46%-53%		
Fully aware	38%-15%	12%-17%		
P (2019-2023)	.064	.218		
In which kind of hearing loss do you prefer BAHI? (2019%-2023% (p (2019-2023)))				
Conductive hearing loss	100%-85% (0.073)	75%-68% (0.316)	.013*	.110
Mixed hearing loss	90%-85% (0.636)	75%-72% (0.730)	.156	.281
Sensorineural hearing loss	21%-12% (0.384)	29%-28% (0.887)	.494	.108
At what level of hearing loss do you BAHI? (2019%-2023%; P (2019-2023))				
Mild hearing loss	45%-67% (0.137)	13%-23% (0.067)	.001*	.001*
Moderate hearing loss	100%-74% (0.014*)	74%-73% (0.895)	.01*	.976
Profound hearing loss	55%-26% (0.043*)	73%-57% (0.020*)	.109	.003*
Total hearing loss	25%-7% (0.094)	10%-11% (0.751)	.059	.535
Indications most preferred by the participants for BAHIs (2019%-2023%(P (2019-2023)))				
Aural atresia/stenosis	80%-54% (0.065)	50%-42% (0.313)	.015*	.268
Sequela of chronic otitis	20%-62% (0.005*)	17%-2% (0.001*)	.754	.074
Persistent external otitis	25%-50% (0.085)	7%-15% (0.075)	.015*	.001*
Mastoidectomy cavity	65%-42% (0.127)	56%-53% (0.718)	.447	.313
In what conditions do you prefer BAHIs? (2019%-2023%(P (2019-2023)))				
Frequent infection in mastoidectomy cavity	50%-39% (0.560)	61%-47% (0.065)	.371	.435
Improper mold due to cavity	65%-50% (0.302)	67%-55% (0.084)	.837	.674
Insufficient amplification due to CHL	90%-50% (0.004*)	75%-69% (0.384)	.144	.063
Frequent otitis externa due to hearing aids	55%-71% (0.241)	46%-53% (0.337)	.448	.075
Sequelae chronic otitis became active after using BTE-HA	75%-64% (0.430)	62%-56% (0.416)	.270	.422
Aural fullness and pressure due to BTE-HA	45%-25% (0.147)	35%-32% (0.676)	.390	.494

Pearson's chi-square test.

BAHI, bone-anchored hearing instruments; BTE-HA, behind-the-ear hearing aids; CHL, conductive hearing loss.

facilitating adequate hearing for the patient. The crux lies in ensuring hearing health professionals possess comprehensive knowledge and are adept at guiding patients down the correct path.

The global challenge of individuals with hearing impairment encountering barriers to essential services has become pronounced. This predicament arises from multiple factors, including insufficient public resources, constrained financial means,

Table 3. The Responses were Compared According to Professional Experience

Experience in Years	0-5	5-10	10-15	15-
Do you follow patients using BTE-HA? (2019%-2023%)				
Yes	78%-46%	81%-44%	38%-89%	76%-74%
P (2019-2023)	.001*	.009*	.027*	.872
Are hearing aids preferred for conductive or mixed hearing loss? (2019%-2023%)				
BTE-HA	69%-34%	55%-39%	88%-44%	64%-50%
BAHI	17%-57%	26%-61%	13%-11%	18%-23%
Both	14%-9%	19%-0%	0%-44%	18%-27%
P (2019-2023)	.001*	.021*	.092	.584
Experience in BAHIs (2019%-2023%)				
None	4%-20%	0%-12%	13%-0%	0%-9%
Basic level	51%-33%	20%-24%	25%-33%	25%-35%
I know, but I don't apply	34%-35%	73%-47%	38%-33%	54%-26%
I am experienced, and I apply	11%-12%	7%-18%	25%-33%	21%-30%
P (2019-2023)	.052	.112	.718	.135
Level of awareness about conditions for BAHIs (2019%-2023%)				
No idea	44%-33%	10%-53%	38%-22%	46%-17%
Have some idea	37%-58%	70%-24%	50%-44%	39%-57%
Fully aware	19%-9%	20%-24%	13%-33%	14%-26%
P (2019-2023)	.065	.002*	.564	.087
Which kind of hearing loss do you prefer, BAHI? (2019%-2023% (P (2019-2023)))				
Conductive hearing loss	73%-73% (0.966)	80%-69% (0.394)	88%-56% (0.149)	82%-74% (0.504)
Mixed hearing loss	64%-77% (0.100)	88%-75% (0.320)	100%-88% (0.156)	89%-74% (0.170)
Sensorineural hearing loss	37%-21% (0.066)	10%-13% (0.795)	25%-22% (0.893)	33%-44% (0.461)
At what level of hearing loss do you prefer BAHI? (2019%-2023% (P (2019-2023)))				
Mild hearing loss	23%/42% (0.023*)	21%-47% (0.061)	0%-11% (0.331)	19%-9% (0.507)
Moderate hearing loss	74%-64% (0.247)	90%-94% (0.604)	88%-78% (0.600)	78%-87% (0.400)
Profound hearing loss	59%/50% (0.356)	69%-41% (0.065)	88%-67% (0.312)	82%/52% (0.027*)
Total hearing loss	11%-8% (0.483)	3%-12% (0.270)	0%-22% (0.156)	26%-13% (0.256)
Indications most preferred by BAHIs (2019%-2023% (P (2019-2023)))				
Aural atresia/stenosis	54%-45% (0.321)	52%-41% (0.489)	29%-50% (0.398)	67%-45% (0.149)
Sequela of chronic otitis	15%/48% (0.001*)	24%-53% (0.048*)	0%-25% (0.155)	21%-45% (0.087)
Persistent external otitis	8%/31% (0.002*)	7%-18% (0.258)	14%-25% (0.605)	17%-5% (0.225)
Mastoidectomy cavity	46%-51% (0.620)	69%-47% (0.142)	71%-38% (0.189)	71%-60% (0.450)
In what conditions, do you prefer BAHIs (2019%-2023% (P (2019-2023)))				
Frequent infection in mastoidectomy cavity	54%-38% (0.078)	71%-44% (0.066)	88%-75% (0.522)	52%-61% (0.510)
Improper mold due to cavity	63%-46% (0.086)	74%-50% (0.086)	88%-63% (0.248)	66%-78% (0.314)
Insufficient amplification due to CHL	71%-62% (0.340)	77%-50% (0.048*)	63%-75% (0.590)	86%-78% (0.452)
Frequent otitis externa due to hearing aids	44%-64% (0.032*)	48%-44% (0.790)	50%-50% (1.0)	55%-48% (0.598)
Sequelae COM became active after using BTE-HA	59%-58% (0.969)	74%/33% (0.005*)	63%-75% (0.590)	59%-74% (0.250)
Aural fullness and pressure due to BTE-HA	38%-28% (0.254)	36%-28% (0.579)	13%-25% (0.522)	41%-44% (0.879)

BAHI, bone-anchored hearing instruments; BTE-HA, behind-the-ear hearing aids; CHL, conductive hearing loss; COM, chronic otitis media.

and inadequate rehabilitation facilities. These issues are pervasive globally, particularly prevalent in developing nations, leading to substantial hardships for those affected by hearing loss.^{7,8} Numerous research endeavors have assessed the efficacy of hearing screening initiatives to address hearing impairments and examine public knowledge and consciousness about hearing health, hearing loss, and auditory well-being, with

particular emphasis on university students.⁸⁻¹⁰ Nonetheless, investigations delving into the awareness and knowledge of hearing health professionals concerning hearing rehabilitation remain scarce within the existing literature.¹¹ To the best of our knowledge, our study is a pioneering effort to evaluate the awareness surrounding BAHIs among hearing health professionals.

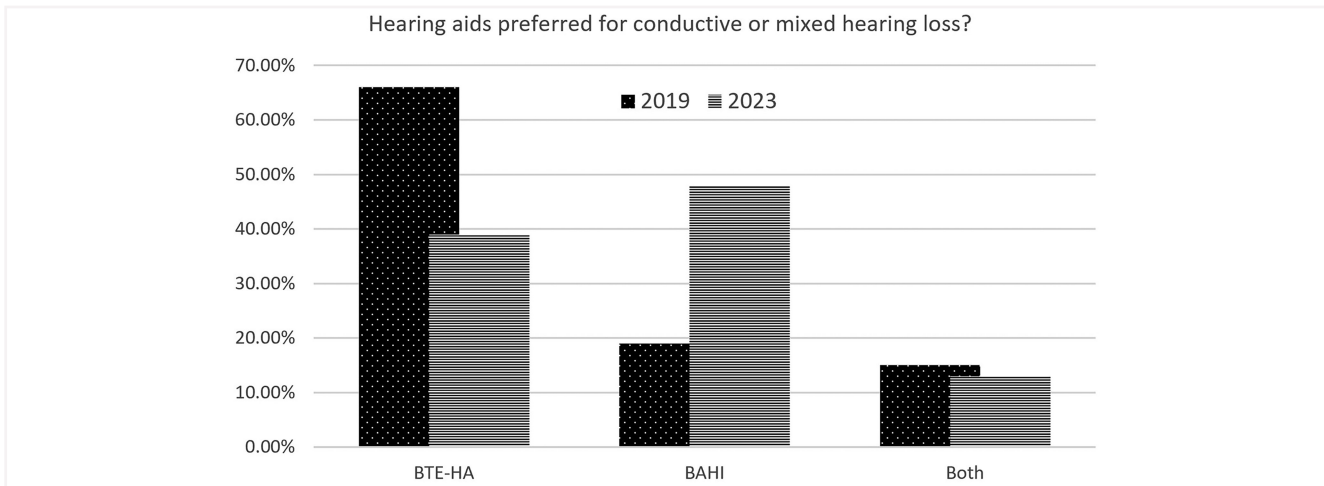


Figure 1. What kind of hearing rehabilitation was preferred for conductive or mixed hearing loss?

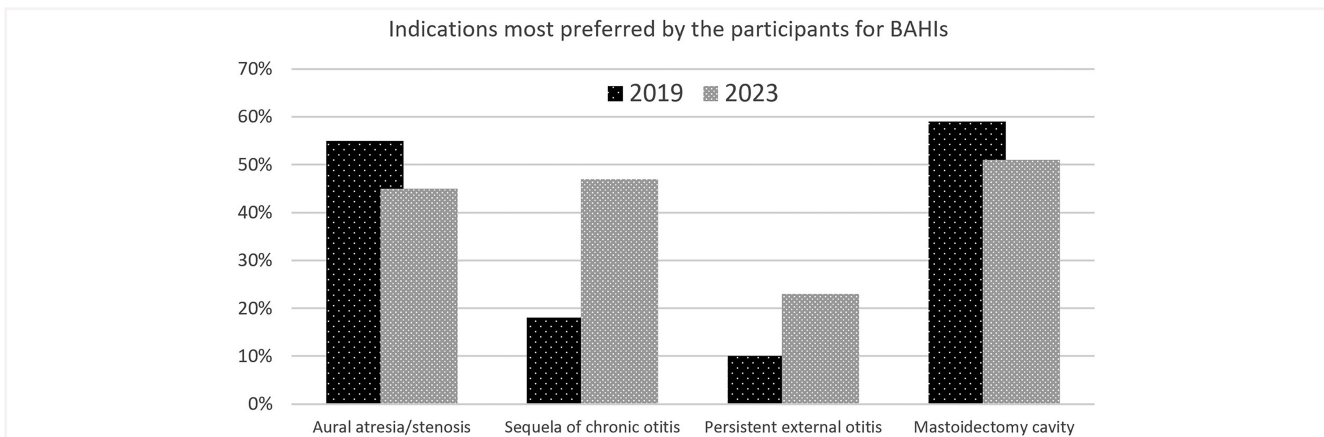


Figure 2. The most preferred indications for bone-anchored hearing instruments.

The majority of individuals with hearing loss can achieve rehabilitation through the utilization of BTE-HA.⁴ However, research has shown that some users cannot use BTE-HA regularly. The reasons for this situation are not always clear, but failure to provide regular follow-up support increases BTE-HA non-user rates.^{12,13} In our study, 75.4% of the participants stated that they followed the patients using BTE-HA in 2019, but this rate dropped to 53.7% in 2023. Proper follow-up of BTE-HA will reduce non-user rates and offer alternative rehabilitation methods for patients who cannot benefit enough.

There is a group of patients where BTE-HA cannot be used due to outer and middle ear pathologies. These patients regularly apply to clinics for auditory hygiene and topical antimicrobial therapy. They also need regular visits to the audiology departments to replace earmolds damaged by the otorrhea or to increase the inadequate hearing aid amplification. In addition, recurrent local infections in the outer and middle ear due to BTE-HA can reduce the patient's auditory performance, preventing the use of the device and affecting the cochlear reserve by damaging the inner ear structures.³⁻⁵ In this group of patients, BAHIs constitute an excellent alternative route. In

our study, the most common reason for preferring BAHIs was the inability to achieve adequate amplification. The most preferred indications were aural atresia (55%) and mastoidectomy cavity (59%) in 2019; sequelae otitis media joined the top list in 2023.

Bone-anchored hearing instruments are effective implantable hearing methods with short surgery time and low complication rates.¹⁴ However, the price of the device and the surgical fee may be costly for the patient. For this reason, it is essential to know the conditions of insurance to cover BAHIs. Only 18% of the participants in our study knew these conditions, which did not increase over time. Today, BAHIs are preferred as an alternative for patients with unilateral sensorineural hearing loss other than patients with conductive and mixed-type hearing loss.^{14,15} In our study, the most common indications for preferring BAHIs were conductive and mixed hearing loss, which did not change over time.

This study represents an innovative endeavor to appraise the expertise and familiarity of hearing health professionals regarding BAHIs. However, certain limitations are inherent in

the cohort selection process, as all participants were attendees of congresses and voluntarily completed the questionnaire. Furthermore, the study lacked a comprehensive understanding of the educational endeavors from 2019 to 2023, focusing on BAHs. The interplay of factors such as the COVID-19 pandemic and economic fluctuations in our country during this period adds complexity. These elements have also influenced participants' perspectives, introducing challenges in staying abreast of educational initiatives, attending to patients, and coping with frequent alterations in reimbursement policies.

Our study underscored a low level of awareness alongside a substantively accurate knowledge foundation concerning BAHs. Both the profession and the duration of professional engagement influenced attitude changes. Hence, it remains imperative to initiate national and international educational campaigns tailored to carefully selected target groups aimed at fostering a heightened awareness of BAHs.

Data Availability: The data will be available upon request to the corresponding author.

Ethics Committee Approval: The ethical approval was granted by the Recep Tayyip Erdogan University Ethics Committee (protocol number: 2019/94, date: 02.10.2019).

Informed Consent: Written informed consent was obtained from the participants who agreed to take part in the study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – F.N.A., E.D.; Design – F.N.A., E.D., Ş.T.; Supervision – F.N.A., E.D., Ş.T.; Resources – F.N.A., E.D., Ş.T., G.A.; Materials – F.N.A., E.D., Ş.T., G.A.; Data Collection and/or Processing – F.N.A., E.D., Ş.T., G.A.; Analysis and/or Interpretation – F.N.A., E.D., Ş.T., G.A.; Literature Search – F.N.A., E.D., Ş.T., G.A.; Writing Manuscript – F.N.A., E.D., Ş.T., G.A.; Critical Review – F.N.A., E.D., Ş.T., G.A.

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Declaration of Interests: The first author was supported for the congress registration. Şengül Terlemez was Cochlear's former clinical technical and research coordinator in 2019. She left the Cochlear Türkiye in 2021. The other authors have no conflict of interest to declare.

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