Original Article / *Özgün Makale*

Development and standardization of Türkiye-Anatolia auditory processing disorder screening questionnaire (TAIBTA)

Türkiye-Anadolu işitsel işleme bozukluğu tarama anketinin (TAIBTA) geliştirilmesi ve standardizasyonu

Fulya Yalçınkaya[1]ⓘ, Işık Sibel Küçükünal[2]ⓘ, Kürşad Karakoç[3]ⓘ, Banu Müjdeci[3]ⓘ

[1]Independent Researcher (Retired Professor), Sinop, Türkiye
[2]Department of Speech and Language Therapy, Faculty of Health Sciences, Gazi University, Ankara, Türkiye
[3]Department of Audiology, Faculty of Health Sciences, Ankara Yıldırım Beyazıt University, Ankara, Türkiye

ABSTRACT

Objectives: This study aims to develop a screening questionnaire targeting symptoms associated with auditory processing disorder (APD).

Patients and Methods: Between March 1, 2022 and June 1, 2024, the Türkiye-Anatolia Auditory Processing Disorder Screening Questionnaire (TAIBTA), consisting of eight illustrated items, was developed. It was administered to two groups: 92 healthy adults (46 males, 46 females; mean age: 20.7±1.4 years; range, 18 to 23 years) who scored ≥153 on the Pragmatics Profile (PP) and 30 age-matched individuals (15 males, 15 females; mean age: 21.3±1.9 years; range, 18 to 24 years) diagnosed with APD based on behavioral auditory tests and who scored <153 on the PP. To assess the validity of the questionnaire, exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) were performed. Internal consistency was evaluated using Cronbach's alpha coefficient. Test-retest reliability was assessed using the intraclass correlation coefficient (ICC), and Spearman rank correlation coefficient was reported as a supportive reliability analysis.

Results: Confirmatory factor analysis demonstrated that the two-factor, eight-item model was supported by fit indices and exhibited a good fit to the data. Cronbach's alpha analysis showed that the questionnaire had adequate internal consistency (α=0.81). The questionnaire demonstrated acceptable temporal stability, as indicated by a significant Spearman correlation coefficient (ρ=0.637, p=0.006), and good absolute agreement, as reflected by a high intraclass correlation coefficient (ICC=0.89).

Conclusion: Our study results suggest that TAIBTA is a reliable, highly sensitive screening questionnaire that can be used routinely. Routine use of the questionnaire for screening purposes can detect the risk of APD.

Keywords: Auditory processing disorder, questionnaire, screening, Türkiye.

ÖZ

Amaç: Bu çalışmada işitsel işlemleme bozukluğu (İİB) semptomlarına yönelik tarama anketi geliştirildi.

Hastalar ve Yöntemler: 01 Mart 2022 ile 01 Haziran 2024 tarihleri arasında sekiz resimli maddeden oluşan Türkiye-Anadolu İşitsel İşleme Bozukluğu Tarama Anketi (TAIBTA) geliştirildi. Anket, iki gruba uygulandı: Dil İletişim Profili (DİP) için ≥153 puan alan 92 sağlıklı birey (46 erkek, 46 kadın; ort. yaş: yıl; 20.7±1.4 dağılım, 18-23 yıl) ile davranışsal işitsel testlere dayanarak İİB tanısı konan ve DİP testinde <153 puan alan yaş uyumlu 30 erişkin birey (15 erkek, 15 kadın; ort. yaş: 21.3±1.9 yıl; dağılım, 18-24 yıl). Anketin geçerlilik analizi için açımlayıcı faktör analizi (AFA) ve doğrulayıcı faktör analizi (DFA) yapıldı. İç tutarlılık, Cronbach alfa analizi ile değerlendirildi. Test-tekrar test güvenirliği, sınıflar arası korelasyon katsayısı (ICC) ile değerlendirildi ve destekleyici analiz olarak Spearman korelasyon katsayısı bildirildi.

Bulgular: Doğrulayıcı faktör AFA sonucu iki faktörlü, sekiz maddelik modelin, uyum indeksleri ile desteklendiği ve veriye iyi bir uyum sergilediği belirlendi. Chronbach alfa analizi anketin yeterli iç tutarlılığa sahip olduğunu (α=0.81) gösterdi. Anket, anlamlı bir Spearman korelasyon katsayısı ile (ρ=0.637, p=0.006) gösterildiği üzere kabul edilebilir zaman içi kararlılık sergiledi ve yüksek bir sınıflar arası korelasyon katsayısı (ICC=0.89) ile yansıtıldığı üzere iyi bir mutlak uyum gösterdi.

Sonuç: Çalışma sonuçlarımız TAİBTA'nın güvenilir, duyarlılığı yüksek, rutin olarak kullanılabilecek bir tarama anketi olduğunu göstermektedir. Anketin tarama amaçlı rutin kullanımı ile İİB riski saptanabilir.

Anahtar sözcükler: İşitsel işlemleme bozukluğu, anket, tarama, Türkiye.

Auditory processing (AP) refers to the set of processes which become engaged, when different acoustic signals reach both ears simultaneously in environments containing multiple auditory stimuli, such as background noise, human speech, and everyday environmental sounds.[1] While individuals may understand speech easily in quiet listening conditions, they may experience difficulties in discriminating and interpreting verbal information in the presence of background noise. Once a marked discrepancy is observed between these two listening conditions, AP disorder (APD) should be suspected.[1] Screening individuals at risk for APD plays a critical role in enabling early identification and timely intervention, thereby contributing to more successful educational outcomes. In this context, behavioral questionnaires and checklists constitute important tools, as they provide valuable information regarding an individual's auditory behaviors from the perspectives of parents and educators. Review of the literature also demonstrates that such behavioral assessment tools are effective methods for screening individuals at risk for APD.[2-6] Pure-tone audiometry does not fully reflect an individual's auditory performance under real-life listening conditions. In contrast, screening questionnaires designed to determine the need for AP assessments offer more functional information regarding how individuals perceive sounds in everyday environments. In the national literature, there is a notable lack of questionnaires and checklists in the Turkish language aimed at screening AP abilities. In the present study, we, therefore, aimed to develop and standardize the Türkiye-Anatolia Auditory Processing Disorder Screening Questionnaire (TAIBTA), consisting of items designed to screen APD-related symptoms and identify the risk of APD in adults. Our objective was to develop a reliable, highly sensitive questionnaire that can be administered in a short time and used routinely for APD screening in adults ensuring that it serves as an effective initial step in determining the need for diagnostic APD tests, thereby facilitating early diagnosis and timely intervention.

PATIENTS AND METHODS

This prospective study was conducted at Faculty of Health Sciences, Department of Speech and Language Therapy between March 1, 2022 and June 1, 2024. The data collection instrument used in this study was the TAIBTA, developed by Yalçınkaya and Keith[1] for screening APD-related symptoms in adults. The sample size was determined based on the number of items included in the questionnaire. In accordance with the recommendations in questionnaire development studies suggesting that the sample size should be at least 10 times the number of items,[7] a total of 122 participants were included: 92 healthy university students (46 males, 46 females; mean age: 20.7±1.4 years; range, 18 to 23 years) and 30 age-matched individuals (15 males, 15 females; mean age: 21.3±1.9 years; range, 18 to 24 years) diagnosed with APD based on behavioral auditory tests. All participants were required to be native Turkish speakers, have normal hearing sensitivity, have no history of neurological or psychiatric disorders, language or speech disorders, and participate voluntarily in the study. Additional inclusion criteria for the healthy group were the absence of an APD diagnosis and a score of ≥153 on the Pragmatics Profile (PP).[8,9] For the APD group, participants were required to have a diagnosis of APD established through behavioral auditory tests and a PP score below 153.

A written informed consent was obtained from each participant. The study protocol was approved by the Ankara Yıldırım Beyazıt University Health Sciences Ethics Committee (Date: 07.02.2022, No: 2022-693). The study was conducted in accordance with the principles of the Declaration of Helsinki.

Questionnaire development process

During the questionnaire development process, the study was conducted systematically by following the steps recommended in the literature for questionnaire development. The stages of this process are outlined below.

Literature review

At this stage, the national and international literature related to the assessment of APD was reviewed.[4,6,10-15] No questionnaire developed in Turkish for the assessment of APD-related symptoms in Turkish-speaking individuals was identified. Following the literature review, the process proceeded to the item pool development stage.

Item pool development

The item pool was developed based on the first author's clinical experience gained over 30 years of academic and clinical practice as a child development specialist and educational audiologist, working with children and adults with APD and speech and language disorders.

In line with the findings from the literature review, the researchers prepared a preliminary 12-item draft questionnaire aimed at screening APD-related symptoms in individuals whose native language is Turkish and submitted it for expert evaluation.

Yalçınkaya F et al. Development and standardization of TAIBTA

iii

Content and face validity

The 12 items identified by Yalçınkaya and the research team were reviewed by three field experts (audiologists, speech therapists, and a speech and language pathologist). The experts independently evaluated each item in terms of conceptual relevance, clarity of language and expression, cultural sensitivity, and the absence of discriminatory statements. Based on expert feedback, four items were removed, resulting in a final set of eight items. Each item in the draft questionnaire was structured using five response options.

Questionnaire characteristics

The developed questionnaire was structured using a five-point Likert scale (0 = never, 1 = rarely, 2 = sometimes, 3 = often, 4 = always). The maximum possible total score was 32. The results were interpreted as either "at risk for APD" or "not at risk for APD", with higher scores indicating an increased risk of APD-related symptoms. When a risk of APD was identified, the questionnaire facilitated referral of the individual for further screening and diagnostic assessments.

Preliminary administration, clarity assessment, and pilot study

The preliminary eight-item draft questionnaire was administered to 20 university students using a paper-and-pencil format. The participants were asked to provide feedback regarding the clarity, comprehensibility, and appropriateness of the item statements. Based on the participants' feedback, three items were revised to improve clarity. In the final version of the eight-item questionnaire, illustrative images were added to each item to enhance comprehensibility.

Administration of the questionnaire

The eight-item questionnaire was administered to 92 healthy university students on a voluntary basis. The questionnaire is presented in Appendix. Printed copies of the questionnaire were provided to the participants, who were instructed to select the response option that best described their listening experiences. To evaluate test-retest reliability, the final version of the questionnaire was re-administered to 20 students after a minimum interval of three days, and the scores were recorded.

Statistical analysis

Statistical analysis was performed using the IBM SPSS version 23.0 software (IBM Corp., Armonk, NY, USA) and RStudio version 2024.09.0 software (R Foundation for Statistical Computing, Vienna, Austria). The normality of the data distribution was assessed using the Kolmogorov-Smirnov and Shapiro-Wilk tests. Descriptive data were presented in mean ± standard deviation (SD), median and interquartile range (IQR) min-max values, or number and frequency, where applicable. To determine the construct validity of the scale, exploratory factor analysis (EFA) was conducted first, followed by confirmatory factor analysis (CFA) to examine model fit indices (comparative fit index [CFI], Tucker-Lewis Index [TLI], root mean square error of approximation [RMSEA], and standardized root mean squared error [SRMR]). The reliability of the scale was calculated using Cronbach's alpha for internal consistency. Test-retest reliability was evaluated using the intraclass correlation coefficient (ICC), and Spearman rank correlation coefficient was reported as a supportive analysis. Comparisons of TAIBTA scores by sex were performed using the Mann-Whitney U test. A p value of <0.05 was considered statistically significant.

RESULTS

Data obtained from 92 healthy individuals (46 females, 46 males) and 30 age-matched participants (15 females, 15 males) diagnosed with APD based on behavioral auditory tests were analyzed. The mean PP score of the healthy participants was 173±35 (range, 133 to 208). No statistically significant difference in age was observed between sexes (p=0.702).

Factor analysis

The factor structure of the eight-item scale was evaluated using EFA and CFA.

Exploratory factor analysis

The results of the EFA indicated that the questionnaire exhibited a two-dimensional structure and that all items had adequate factor loadings (Table 1). Factor loadings of the items ranged from 0.534 to 0.877, exceeding the commonly accepted criterion of 0.40 for item retention.[16]

The EFA results for the eight-item questionnaire supported a two-factor structure. The first factor (Items 1, 2, 3, and 7) accounted for 24.9% of the total variance, while the second factor (Items 4, 5, 6, and 8) explained 18.5% of the variance. Together, the two factors accounted for 43.4% of the total variance. The first factor represented speech intelligibility and dichotic listening, whereas the second factor represented auditory temporal processing and auditory closure.

Table 1		
Results of exploratory factor analysis for TAIBTA		
Items	Factor loadings	
	Factor 1 Speech intelligibility and dichotic listening (Items 1, 2, 3, 7)	**Factor 2** Auditory temporal processing, auditory closure (Items 4, 5, 6, 8)
Item 1 Birden fazla uyaranın (konuşma sesleri, gürültüler, ortamdan gelen sesler) olduğu ortamlarda, seçtiğiniz kişinin devam eden konuşmalarını dinlerken, bazı sesleri bozuk anlar mısınız? (Örn: Sınıfta, yanınızdaki arkadaşınızın konuşmalarını dinlerken)	0.877	
Item 2 Her iki kulağınıza farklı konuşmalar aynı anda geldiğinde konuşmaları bozuk anlar mısınız?	0.534	
Item 3 Arka plandan gürültü sesleri gelirken, sohbet ettiğiniz kişinin konuşmalarını bozuk anlar mısınız?	0.704	
Item 7 Kalabalık ortamlarda (sınıf, market, dolmuş, vs.) konuşmaları duymanıza rağmen bozuk anlar mısınız?	0.656	
Item 4 Akustiği iyi olmayan, yankı ve eko yapan ortamlarda konuşmaları bozuk anlar mısınız?		0.574
Item 5 Hızlı konuşan kişilerin konuşmalarını bozuk anlar mısınız? (Örn: Radyoda, televizyonda hızlı konuşan kişilerin veya ders anlatan öğretmenlerin hızlı konuşması durumunda).		0.584
Item 6 Konuşma şivesi farklı olan kişilerin konuşmalarını bozuk anlar mısınız? (Örn: Yeni tanıştığınız kişilerin, aile büyüklerinizden birinin veya ülkenin farklı bölgelerinden gelen birinin konuşması)		0.571
Item 8 Karmaşık çoklu yönergeleri takip etmekte güçlük çeker misiniz? (Örn:Dolmuş şöförüne metrodan geçip geçmediğini sor, eğer geçiyorsa iki bilet al, gel)		0.610
Variance explained by the factor	24.9	18.5
Total variance explained	43.4	
TAIBTA: Türkiye-Anatolia Auditory Processing Disorder Screening Questionnaire.		

Internal consistency reliability

The internal consistency of the eight-item questionnaire was evaluated using Cronbach's alpha coefficient. Reliability analyses were first conducted at the factor level and subsequently for the total scale. The Cronbach's alpha value for the overall questionnaire was $\alpha=0.81$ (Table 2). When the subscales were examined, the Cronbach's alpha coefficient was $\alpha=0.83$ for the first factor and $\alpha=0.69$ for the second factor. A Cronbach's alpha value above 0.70 is usually considered indicative of adequate internal consistency.[17] Accordingly, TAIBTA demonstrated adequate internal consistency reliability.

Confirmatory factor analysis

Within the scope of CFA, model fit was evaluated using the goodness-of-fit indices NFI, GFI, RFI, CFI, and RMSEA. The CFA results demonstrated that the two-factor, eight-item model exhibited a good fit to the data (CFI=1.00, TLI=1.00, RMSEA
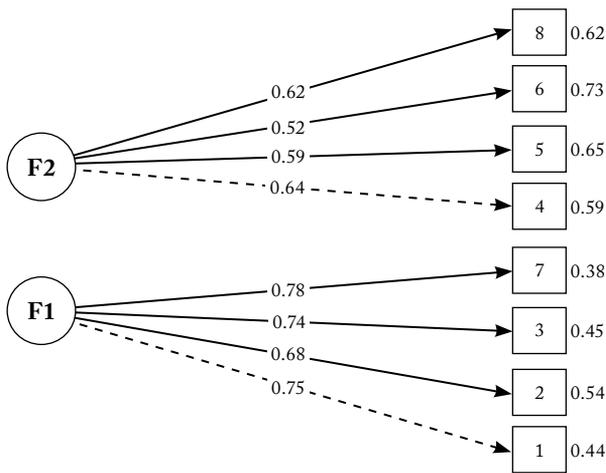
Yalçınkaya F et al. Development and standardization of TAIBTA

v

Figure 1. Confirmatory factor analysis model.

<0.001, SRMR=0.045). These findings confirm the two-dimensional structure of the scale. The CFA model is presented in Figure 1.

Test-retest reliability

The test–retest reliability of the questionnaire was evaluated using both the ICC and Spearman rank correlation analysis. For this purpose, the questionnaire was re-administered to the same participants (n=20) with a minimum interval of one week, and total scores were analyzed. Spearman correlation analysis revealed a moderate-to-high,

positive, and statistically significant association between the total scores obtained from the two administrations (ρ=0.637, p=0.006) (Table 2), indicating that the questionnaire demonstrated an acceptable level of temporal stability. The ICC value, calculated using a two-way random-effects model with absolute agreement and single measures [ICC (2,1)], was 0.89, indicating good absolute reliability. Overall, TAIBTA was found to exhibit satisfactory temporal stability.

TAIBTA scores by sex in healthy individuals

When healthy individuals were evaluated according to sex, the mean TAIBTA total score in females was 7.58±3.96, with a mean Factor 1 score of 3.89±2.21 and a mean Factor 2 score of 3.67±2.32. In males, the mean TAIBTA total score was 7.95±3.89, the mean Factor 1 score was 4.26±2.45, and the mean Factor 2 score was 3.69±2.10. No statistically significant differences were observed between females and males in terms of the TAIBTA total score, Factor 1 score, or Factor 2 score (p=0.692) (Table 3). Median, and IQR values are presented in Table 3.

Comparison of TAIBTA findings between healthy individuals and individuals with APD

Among healthy individuals, the mean TAIBTA total score was 7.77±3.91 (min=0; max=18), with a mean Factor 1 score of 4.07±2.33 (min=0; max=14) and a mean Factor 2 score of 3.68±2.20 (min=0; max=9). In the evaluation of the 30 participants

Table 2 TAIBTA reliability coefficient			
Reliability analysis	Coefficient	n	p
Cronbach's alpha	0.83	92	-
Test–retest reliability	0.637	20	0.006
TAIBTA: Türkiye-Anatolia Auditory Processing Disorder Screening Questionnaire.			

Table 3 TAIBTA findings by sex					
	Female (n=46)		Male (n=46)		
	Median	IQR	Median	IQR	p^*
Total score	7	4.75-11	7	5-10	0.796
Factor 1	4	2.75-5	4	3-5	0.692
Speech intelligibility and dichotic listening (Items 1, 2, 3, 7)					
Factor 2	4	2-5.25	3	2-5	0.972
Auditory temporal processing, auditory closure (Items 4,5,6,8)					
TAIBTA: Türkiye-Anatolia Auditory Processing Disorder Screening Questionnaire; IQR: Interquartile range; * Mann-Whitney U test; p<0.05.					

	Total score		Factor 1 Speech intelligibility and dichotic listening (Items 1, 2, 3, 7)		Factor 2 Auditory temporal processing, auditory closure (Items 4, 5, 6, 8)	
	Median	IQR	Median	IQR	Median	IQR
Healthy participants (n=92)	7	5-10	4	3-5	3	2-5
Participants with APD (n=30)	13	10-16	6.5	5-9	7	5-8

Table 4
TAIBTA results for APD individuals and healthy individuals

TAIBTA: Türkiye-Anatolia Auditory Processing Disorder Screening Questionnaire; APD: Auditory Processing Disorder; IQR: Interquartile range.

diagnosed with APD, the mean TAIBTA total score was 13.03 ± 3.71 (min=6; max=21). The mean score for Factor 1 was 6.40 ± 1.99, and the mean score for Factor 2 was 6.50 ± 2.11. The mean TAIBTA total score, as well as the mean scores for Factor 1 and Factor 2, were markedly higher in individuals with APD compared to healthy individuals. In addition, TAIBTA total scores in the APD group were found to be consistent with the results of behavioral auditory tests, supporting the validity of TAIBTA (Table 4). Median, and IQR values are presented together in Table 4.

DISCUSSION

In the present study, we developed TAIBTA, a screening questionnaire designed to identify APD-related symptoms and determine the risk of APD. The findings demonstrated that TAIBTA was a valid and reliable instrument, thereby contributing a Türkiye-Anatolia APD risk screening questionnaire to the literature. The results of the present study indicate that TAIBTA can be used as a screening and referral tool to identify individuals at risk for APD and to guide decisions regarding the need for further diagnostic evaluation.

The development of the TAIBTA items was grounded in the clinical experience of the first author, who has been actively involved in the diagnostic and therapeutic management of individuals with APD. Following the administration of the developed items, EFA revealed that the questionnaire supported a two-factor structure. The first factor represented speech intelligibility and dichotic listening, while the second factor represented auditory temporal processing and auditory closure.

Confirmatory factor analysis of TAIBTA demonstrated that the two-factor, eight-item model was supported by goodness-of-fit indices and exhibited a good fit to the data. Cronbach's alpha analysis indicated that the questionnaire had adequate internal consistency ($\alpha=0.81$). In addition, the questionnaire demonstrated an acceptable level of temporal stability, as reflected by a significant Spearman correlation coefficient ($\rho=0.637$, p=0.006), and good absolute agreement, as indicated by a high ICC (ICC=0.89).

Findings from large-scale studies in the literature are also noteworthy. In a comprehensive study conducted among first- and eighth-grade students in primary schools in Warsaw, the prevalence of undiagnosed hearing loss and APD was evaluated. Among a total of 15,659 students, abnormal test results were identified in 1,946 children. Of these, 678 exhibited abnormalities in hearing screening tests, while reduced AP performance was detected in 1,268 students. These findings further highlight the importance of conducting both peripheral and central auditory assessments in school-aged children.[18] The diagnosis and management of APD are also crucial for promoting optimal learning and communication skills in adolescents and adults. APD affects individuals' ability to process auditory information effectively, which may substantially impair academic performance and social interactions. Behavioral questionnaires and checklists have therefore emerged as essential tools for screening individuals at risk for APD. By incorporating both self-reports and observations from third parties such as parents or educators, these tools provide valuable insights into everyday auditory functioning.

The Turkish version of the Amsterdam Inventory for Auditory Disability and Handicap (T-AIADH)[12] includes items that help assess perceived auditory difficulties. T-AIADH facilitates the early identification of auditory disability and provides information which may guide targeted interventions aimed at reducing the impact of hearing loss. The T-AIADH consists of 30 items and is designed to identify disability and handicap related to impairments across five core auditory functions:

Yalçınkaya F et al. Development and standardization of TAIBTA

vii

distinction of sounds, intelligibility in noise, auditory localization, intelligibility in quiet, and detection of sounds. The Auditory Processing Domains Questionnaire (APDQ) is another structured tool developed to evaluate individuals' perceived auditory difficulties.[19] The APDQ is a 52-item questionnaire intended to monitor individuals who may be at risk for APD due to auditory difficulties associated with chronic anomalies or cognitive processing disorders. It is used to assess auditory abilities, hearing-related problems, language skills, and certain aspects of attention. In contrast, TAIBTA is a valid and reliable questionnaire consisting of eight items, designed to identify risk related to core AP functions and to be administered within a short time. This feature represents a distinct advantage of TAIBTA for routine screening purposes. In addition, TAIBTA allows individuals to self-assess their risk for APD, further enhancing its practical utility in clinical and screening contexts.

Nardez et al.[20] emphasized that self-perception questionnaires might be consistent with objective assessments and could effectively identify potential auditory difficulties in adolescents. Furthermore, the use of such checklists in educational settings may facilitate early intervention strategies. Educators can systematically report their observations, enabling the collection of valuable information on how AP difficulties manifest in academic performance and everyday communication. Similarly, Bhise et al.[21] highlighted the importance of self-monitoring through checklists, demonstrating that these approaches could significantly enhance learners' awareness of their own auditory behaviors. Screening questionnaires can be safely used as APD risk screening tools not only in clinical settings, but also in special education institutions and schools. Classroom teachers and special education teachers may use these questionnaires to identify the risk of APD-related symptoms in students they work with and, when necessary, refer them for diagnostic assessments. In addition, parents can easily evaluate their children's risk for APD using these screening questionnaires.

Questionnaire-based studies developed to screen the risk of APD have demonstrated the availability of valid and reliable tools for identifying various listening difficulties and educational risks. In this context, the Children's Auditory Performance Scale (CHAPS), which evaluates everyday listening performance in children, has been adapted into Turkish, with its six-factor structure confirmed and high internal consistency reported (Cronbach's

alpha=0.97).[10] Similarly, the Turkish version of the Screening Instrument for Targeting Educational Risk (S.I.F.T.E.R.) has been shown to be a valid and reliable tool for screening academic risks in students with hearing loss.[13] However, a study conducted by Wilson et al.[15] demonstrated that behavioral questionnaires such as CHAPS and S.I.F.T.E.R. could not predict diagnostic AP test outcomes or APD risk with high accuracy, showing weak-to-moderate correlations. These findings suggest that such tools should be used to highlight concerns rather than to establish a diagnosis. In addition, instruments developed to assess listening difficulties in adolescent and adult populations, such as the University of Cincinnati Auditory Processing Inventory (UCAPI), have been proposed as potential tools to address the gap left by pediatric-focused questionnaires in these age groups.[11] In the light of these findings, questionnaires intended for APD risk screening should be designed to address the target age group, cultural context, and multiple dimensions of listening difficulties. Moreover, it is evident that these screening tools should not be considered sufficient on their own to determine the need for diagnostic evaluation, but rather should function as a filter guiding a comprehensive clinical assessment process. In line with Wilson's perspective, TAIBTA was developed as a screening instrument rather than a diagnostic tool. Given the complex nature of AP functions, establishing a diagnosis of APD based solely on questionnaire data is challenging. TAIBTA provides a categorical outcome of "at risk for APD" or "not at risk for APD", thereby facilitating appropriate referral for diagnostic testing when necessary. This approach may also contribute to time and cost efficiency by ensuring that only individuals who require further diagnostic assessment are referred for comprehensive testing.

One limitation of this study is that qualitative methods (e.g., interviews or focus groups) were not employed during the item generation phase. Another limitation of this study is that the sample consisted solely of healthy university students, and individuals from different educational levels were not included. Therefore, the generalizability of the findings to populations with diverse educational backgrounds may be limited.

In conclusion, TAIBTA addresses a critical need for the early identification of APD risk in the adult population by building upon existing tools with established validity and reliability. Referral of individuals identified as being at risk through TAIBTA may facilitate timely access to appropriate diagnostic evaluation and necessary interventions. The routine

use of TAIBTA is, therefore, recommended in both clinical and educational settings, although further studies are warranted to confirm its effectiveness across diverse populations and contexts.

Data Sharing Statement: The data that support the findings of this study are available from the corresponding author upon reasonable request.

Author Contributions: F.Y., I.S.K., K.K., B.M.: Design/idea, critical interpretation, data collection; F.Y., I.S.K., B.M.: Literature review, supervision/control, data analysis and article writing; I.S.K., B.M.: Language editing and article editing.

Conflict of Interest: The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.

Funding: The authors received no financial support for the research and/or authorship of this article.

REFERENCES

1. Yalçınkaya F, Keith RW. Santral İşitsel İşlemleme Bozuklukları. Tarama, Tanı ve Eğitsel Tedaviler. Ankara: Hipokrat Yayıncılık; 2024.

2. Gitto M, Motta N, Aldè M, Zanetti D, Di Berardino F. Auditory processing disorders: Navigating the diagnostic maze of central hearing losses. J Clin Med 2025;14:2256. doi: 10.3390/jcm14072256.

3. Pereira LD. Introduction to central auditory processing. In: Bevilacqua MC, Balen SA, Martinez MAN, Pupo AC, Reis ACMB, Frota S, editors. Audiology treaty. 1st ed. São Paulo, SP: Santos; 2011. p. 285-8.

4. Donadon C, Pinto SNFR, Couto CM, Colella-Santos MF. Children's Auditory Performance Scale (CHAPS) questionnaire: cross-cultural adaptation to Brazilian Portuguese In: Annals of 14th Congress of Othorinolaringology Foundation; 2015. p. S72. Available at: https://issuu. com/aiorl/docs/iao 14 congress fo final /76 Accessed: 02.09.2017.

5. Luz DMd, Costa-Ferreira MIDd. Identification of risk factors for the (central) auditory processing disorder in preschool children. Revista CEFAC 2011;13:657-667. doi: 10.1590/S1516-18462011005000004.

6. Geffner DS, Ross-Swain D. The listening inventory. Novato, CA: Academic Therapy Publications; 2006.

7. Boateng GO, Neilands TB, Frongillo EA, Melgar-Quiñonez HR, Young SL. Best practices for developing and validating scales for health, social, and behavioral research: A primer. Front Public Health 2018;6:149. doi: 10.3389/fpubh.2018.00149.

8. Yalçınkaya F, Belgin E. 9-21 yaş Dilin Klinik Değerlendirilmesi (DKD-4). Hacettepe Üniversitesi Odyoloji Bilim Dalı, Eğitim Odyolojisi, Ankara: Hacettepe Üniversitesi Hastaneleri Basımevi; 2007.

9. Semel E, Wiig EH, Secord WA. CELF®-4 Clinical Evaluation of Language Fundamentals. 4th ed. Examiner's Manuel. Texas: Harcourt Assessment, Inc; 2003. p. 157-60.

10. Baydan M, Aslan F, Yılmaz S, Yalçınkaya F. Children's auditory performance scale: Turkish validity and reliability. Hacettepe University Faculty of Health Sciences Journal 2020;7:32-40. doi: 10.21020/husbfd.635851.

11. Keith RW, Tektas M, Ramsay K, Delaney S. Development and standardization of the University of Cincinnati Auditory Processing Inventory (UCAPI)†. Int J Audiol 2019;58:373-8. doi: 10.1080/14992027.2019.1585973.

12. Mujdeci B, Inal O, Turkyilmaz MD, Kose K. Turkish translation, reliability and validity of the amsterdam inventory for auditory disability and handicap. JISHA 2016;30:40-6. doi: 10.4103/jisha.JISHA_1_17.

13. Tokgoz-Yilmaz S, Hancer H, Orak O. Validity and reliability of Turkish version of the secondary screening instrument for targeting educational risk questionnaires. Speech Lang. Hear 2025;28:1-8. doi: 10.1080/2050571X.2024.2326362.

14. Volpatto FL, Rechia IC, Lessa AH, Soldera CLC, Ferreira MIDDC, Machado MS. Questionnaires and checklists for central auditory processing screening used in Brazil: A systematic review. Braz J Otorhinolaryngol 2019;85:99-110. doi: 10.1016/j.bjorl.2018.05.003.

15. Wilson WJ, Jackson A, Pender A, Rose C, Wilson J, Heine C, et al. The CHAPS, SIFTER, and TAPS-R as predictors of (C)AP skills and (C)APD. J Speech Lang Hear Res 2011;54:278-91. doi: 10.1044/1092-4388(2010/09-0273).

16. Costello AB, Osborne J. Best practices in exploratory factor analysis: four recommendations for getting the most from your analysis. Pract Assess Res Eval 2005;10:1-9.

17. Tavakol M, Dennick R. Making sense of Cronbach's alpha. Int J Med Educ 2011;2:53-5. doi: 10.5116/ijme.4dfb.8dfd.

18. Skarżyński PH, Czajka N, Bukato E, Zdanowicz R, Kołodziejak A, Skarżyński H. The importance of hearing screening and central auditory processing in school-aged children. Children (Basel) 2024;11:1450. doi: 10.3390/children11121450.

19. Samara M, Thai-Van H, Ptok M, Glarou E, Veuillet E, Miller S, et al. A systematic review and metanalysis of questionnaires used for auditory processing screening and evaluation. Front Neurol 2023;14:1243170. doi: 10.3389/fneur.2023.1243170.

20. Nardez TMB, Guijo LM, Lucas PA, Cardoso ACV. Adolescents' self-perception about auditory behavior: Agreement with parents and central auditory processing evaluation. Int Arch Otorhinolaryngol 2021;26:e038-45. doi: 10.1055/s-0040-1718966.

21. Bhise N, Mishra V, Pisulkar S, Nimonkar S, Srivastava T, Belkhode V. Evaluation of a product-centered learning behaviors for adolescent and adult learners using a validated learning behavior questionnaire: A mixed-method analytical cross-sectional study. Cureus 2022;14:e26954. doi: 10.7759/cureus.26954.

Yalçınkaya F et al. Development and standardization of TAIBTA

ix

APPENDIX

| **Türkiye-Anadolu İşitsel İşlemleme Bozukluğu Tarama Anketi (TAİBTA)** |

| Lütfen her soruyu dikkatle okuyunuz ve her soru için cevabınız olan seçeneği işaretleyiniz. |

1. Birden fazla uyaranın (konuşma sesleri, gürültüler, ortamdan gelen sesler) olduğu ortamlarda, seçtiğiniz kişinin devam eden konuşmalarını dinlerken, bazı sesleri bozuk anlar mısınız? (Örn: Sınıfta, yanınızdaki arkadaşınızın konuşmalarını dinlerken)

0. Asla
1. Nadiren
2. Arada sırada
3. Sık sık
4. Her zaman

2. Her iki kulağınıza farklı konuşmalar aynı anda geldiğinde konuşmaları bozuk anlar mısınız?

0. Asla
1. Nadiren
2. Arada sırada
3. Sık sık
4. Her zaman

3. Arka plandan gürültü sesleri gelirken, sohbet ettiğiniz kişinin konuşmalarını bozuk anlar mısınız?

0. Asla
1. Nadiren
2. Arada sırada
3. Sık sık
4. Her zaman

4. Akustiği iyi olmayan, yankı ve eko yapan ortamlarda konuşmaları bozuk anlar mısınız?

0. Asla
1. Nadiren
2. Arada sırada
3. Sık sık
4. Her zaman

5. Hızlı konuşan kişilerin konuşmalarını bozuk anlar mısınız? (Örn: Radyoda, televizyonda hızlı konuşan kişilerin veya ders anlatan öğretmenlerin hızlı konuşması durumunda).

0. Asla
1. Nadiren
2. Arada sırada
3. Sık sık
4. Her zaman

6.. Konuşma şivesi farklı olan kişilerin konuşmalarını bozuk anlar mısınız? (Örn: Yeni tanıştığınız kişilerin, aile büyüklerinizden birinin veya ülkenin farklı bölgelerinden gelen birinin konuşması)		
		0. Asla 1. Nadiren 2. Arada sırada 3. Sık sık 4. Her zaman
7. Kalabalık ortamlarda (sınıf, market, dolmuş, vs.) konuşmaları duymanıza rağmen bozuk anlar mısınız?		
		0. Asla 1. Nadiren 2. Arada sırada 3. Sık sık 4. Her zaman
8. Karmaşık çoklu yönergeleri takip etmekte güçlük çeker misiniz? (Örn: Dolmuş şoförüne metrodan geçip geçmediğini sor, eğer geçiyorsa iki bilet al, gel)		
		0. Asla 1. Nadiren 2. Arada sırada 3. Sık sık 4. Her zaman

	(0) Puan	(1) Puan	(2) Puan	(3) Puan	(4) Puan
Toplam					
Genel toplam					