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EVALUATING NORM INDICATORS OF PITCH PATTERN TEST USING THE WHISPERING METHOD IN 8-12-YEAR-OLD RIGHT-HANDED AND PERSIAN-SPEAKING CHILDREN

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ABSTRACT

The pitch pattern test is one of the auditory processing evaluation tests, estimated to have a sensitivity of about 30%. During this test, three tones with different pitches are presented to a person's ears, and he must recognize their pattern and respond in the prescribed manner. One of these ways of expression is imitating or whispering a pattern. This research evaluated and calculated the pitch pattern recognition indices for 139 right-handed and Persian-speaking children aged 8 to 12. The children included 63 boys with an average age of 10.05±1.47 years and 76 girls with an average age of 1.04±1.40 years, who were randomly collected from primary schools.

The data of the pitch pattern test using the whispering method did not show any significant difference between boys and girls. These data also showed that this method will not differ between the left and right ear scores. However, increasing the child's age between 8 and 12 can improve the scores. despite the improvement of pitch pattern test results with increasing age in children, children's gender does not affect these results. The degree of discrimination of the pitch pattern for the left and right ears using the whispering method is also the same.

Keywords: *Pitch pattern test, Whispering, Auditory processing*

INTRODUCTION

Auditory processing is an ability and skill through which the auditory nervous system uses and benefits from auditory information. This phenomenon includes the understandable processing of auditory information and the neurobiological activities responsible for this processing, leading to the electrophysiological potentials of hearing (1).

According to the definition provided by the American Speech Language and Hearing Association, auditory processing disorder is a heterogeneous problem caused by damage to different aspects of auditory processing, such as auditory discrimination, auditory pattern recognition, and temporal aspects of hearing and hearing function in the presence of competing signals (1), which leads to various symptoms and complaints in the affected populations (2).

Over the past few decades, many tests have been designed, adjusted, and used to examine central auditory processing. Behavioral tests in the evaluation of auditory processing disorder are

classified into two groups: speech tests and non-speech tests. The tests in these two categories are classified based on the characteristic and differential sensitivity in evaluating a specific mechanism in the hearing aid. One of these non-speech tests is the pitch pattern test.

This test shows a person's ability in auditory pattern recognition and temporal processing (3). The test is designed and implemented as three and four patterns. In the triple sample, the test includes different patterns of three Tones Burst (two congruent sounds and one non-congruent sound). This test was designed to investigate auditory complications caused by brain lesions (4). Children's performance in the pitch pattern test is strongly influenced by timing instructions, the number of stimuli, and the type of response required (5). In addition, the understanding of these listening patterns is also affected by the acoustic features of the stimulus, attention, working memory, and experience (6). The children's version of this test includes a three-tone series of two bass (880 Hz) or low (1430 Hz) stimuli; the duration of each tone is 500 milliseconds, and their rise and fall time is ten milliseconds. The interval between two consecutive tones is three hundred milliseconds, and the intervals between each series of consecutive stimuli are ten seconds, presented at the hearing level of 50 dB HL (7). In the special sample for adults, which is for ages ten years and above, two frequencies of 880 Hz and 1122 Hz are used, and the duration of each tone is two hundred milliseconds. The intervals between them are one hundred and fifty milliseconds, the rising and falling time is ten milliseconds, and the intervals between each series of stimuli are also six seconds. (8). After hearing the sounds, the person should point out the pattern of its pitch sequence or imitate it. To express or indicate, the child is taught to specify the order of powers with the titles of sharp and thick, thin and dense, or pitch. Earlier, after cross-sectional training and by presenting the corresponding pitch and pitch, we familiarized him with the name and title of each pitch. But in imitating or whispering, we use vowels or consonants with basic frequency and high and low harmonies. This test is basically a subset of auditory processing system temporal pattern tests (9) and is particularly sensitive to brain hemisphere lesions and connections between the two hemispheres (10).

The norm indicators for comparing and distinguishing cases with weakness and suspected auditory processing disorder are essential in diagnosing these cases. This research tries to obtain these norm criteria using the method of pitch and tone imitation in children aged 8 to 12 and analyze and interpret them.

MATERIALS AND METHODS

Participants

This research included 139 Persian-speaking children aged 8 to 12 years with an average age of 10.04±1.43 years, including 63 boys with an average age of 10.05±1.47 years and 76 girls with an average age of 1.04±1.40 years.

All children had a natural hearing threshold (≤ 15dB) within the audiometric frequencies (ANSI, 2004) and indicated natural speech discrimination scores (≥ 92%) (11). The children lacked any history of neurological or psychological diseases. Also, using the Edinburgh Handedness Inventory (EHI) test, we confirmed their right-hand dominance (12). The children had no prior

history of long-term hospitalization, surgical interventions, and chronic middle-ear infection. Also, all samples were within the natural intelligence range (≥ 85) of the Leiter Adult Intelligence Scale (LAIS) (13).

Pitch Pattern Test

The pitch pattern test is among the most common auditory processing tests (14). This test consists of three consecutive tones, the frequency of one of which is opposite to the other two tones (15).

The test was performed by whispering or imitating the pitch pattern. Therefore, the child was simply asked to express the presented pitches using two corresponding vowels, for example, "ou" and "ie" or "o" and "e" or its combination with selected consonants in the form of the consonant-vowel. This means that the child should use the vowel "ou" or "o" to imitate the low sounds and use the vowel "ie" or "a" to imitate the following sounds. For example, if the pattern was treble-treble-bass, the whispering process would be "e" - "e" - "o" or "ie"-"ie"-"ou" or "di"-"di"-"dou" or "de"-"de"-"do" or other corresponding cases. After detailed training, answers are acceptable when the sounds with the corresponding vowels are whispered correctly and at the corresponding basic frequency. Triple patterns (for example, 880-880-1430 Hz) are randomly presented to the subject as a single earpiece, and the number of patterns correctly recognized in each ear is recorded. This test includes a version for children "6 to 9 years old" and an adult version "9 to 65 years old", which was used according to the age of the child (3).

It should be noted that the level of presentation is usually set at 50 dB HL and is not important in normal people because the frequency pattern test reaches its maximum performance at the level of 10-15 dB SL, and its implementation at 20 dB SL or 50 dB SL level will make no difference in normal people (8). The presentation level in our research, 50 dB HL, is approximately equal to the sound pressure level of 70 dB SPL in these frequencies (15).

Data analysis

The statistical data included the average scores of the pitch pattern test and their standard deviation. Analysis of variance was used to compare the averages of different groups, and Spearman's correlation coefficient test was used to check the relationship between variables. The data were statistically analyzed using SPSS 22 software.

RESULTS AND DISCUSSION

The pitch pattern test score was obtained using the whispering method for 139 Persian-speaking children aged 8 to 12 years with an average age of 10.04±1.43 years, including 63 boys with an average age of 10.05±1.47 years and 76 girls with an average age of 1.04±1.40 years. Statistical evaluations did not show any difference between the average age of boys and girls (P=0.622). **Table 1** shows the age distribution of the children in the study.

Table 1. the frequency distribution of the children by age.

Age Range (years/months)	Number	Percent
8/00-8/11	21	**15.1**
9/00-9/11	30	**21.6**

10/00-10/11	28	**20.1**
11/00-11/11	33	**23.7**
12/00-12/11	27	**19.4**
Total	139	**100**

In the following, you can see the results of the pitch pattern test with the whispering method in **Table 2.** This Table presents the average score in percentage along with its standard deviation for each age.

Table 2. Average estimated normal score of pitch pattern test based on age

Age Range (years/months)	Right ear± SD (percentage)	Left ear± SD (percentage)
8/00-8/11	68.07 ± 9.21	**67.59 ± 10.73**
9/00-9/11	75.17 ± 8.93	**74.2 ± 10.23**
10/00-10/11	77.83 ± 9.57	**76.64 ± 8.36**
11/00-11/11	81.31 ± 12.4	**83.31 ± 12.66**
12/00-12/11	83.5 ± 11.83	**83.51 ± 9.998**

Pitch is the perceptual manifestation of the frequency of sounds and is defined as an auditory perceptual sign that can classify sounds on a scale from low to high (16). Based on this, two sounds can be separated based on pitch, called high and low or sharp and thick. Such an action requires the intervention of senses other than hearing in information processing. This makes the task difficult and more likely to make performance errors, especially for children. The effects of this phenomenon can be observed in the test results. For example, when oral expression is used to express the pitch pattern, the speech centers are also activated, and the child must process the words to match the appropriate concepts and express the relevant pattern. This phenomenon is also affected by the difference in the processing centers of the two hemispheres and can affect the results of the two ears in a different way (8). On the other hand, using voice imitation and whispering can prevent the intervention of other brain processing centers and lead to higher scores (15).

The general average of the scores obtained from the present study does not show any difference between the left and right ear in whispering the pitch pattern (P=0.909). The separation of children according to age also did not show any difference between the scores of the ears in any of the ages. So, it is possible to imagine a similar processing process for this test pattern and its corresponding response in the two cerebral hemispheres. On the other hand, the results of the pitch pattern test neither in the right ear (P=0.158) nor the left ear (P=0.514) show any difference between the two sexes. Therefore, it is impossible to imagine a processing difference for this test in both sexes.

The only indicator of difference in this test is possibly the effect of age on its results. The evaluation of the relationship between age and pitch pattern test scores shows improvement in results with increasing age in both the right and left ears (P<0.001).

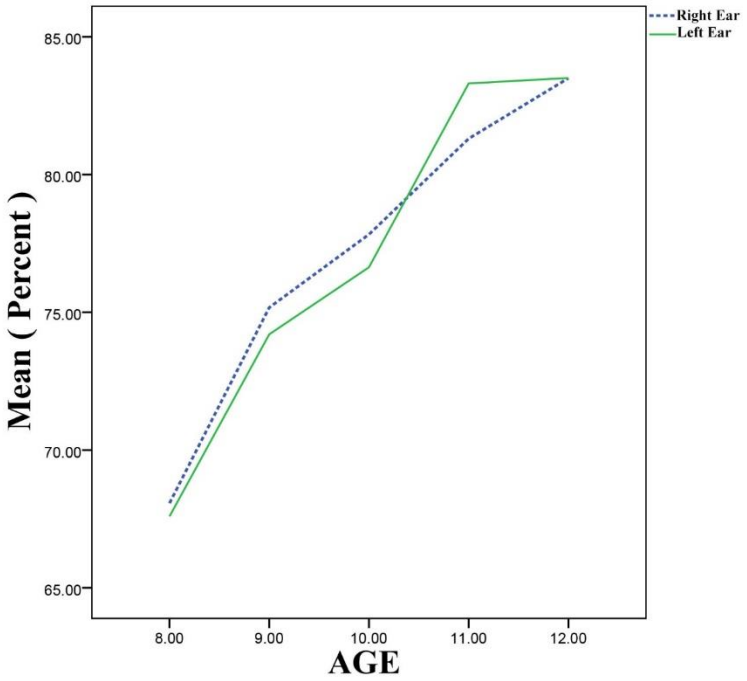

Figure 1. The average score of the pitch pattern test in whispering at different ages (years) for left and right ears

As observed in **Figure 1**, increasing the child's age from 8 to 12 improves test scores. This growth process continues until the age of 12 in the right ear, but as observed in the diagram, these values reach maturity at 11 years in the left ear. This difference was not significant, but it may be considered a sign of the difference between the processing centers of the two hemispheres or the difference in the growth and maturity of this center in the brain's two hemispheres.

CONCLUSION

With increasing age, pitch pattern test scores with the whispering or imitating method significantly improve. These results do not show any difference between the left and right ears in any age group, while the children's gender does not affect the values of these scores.

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