

Assessment of Auditory Processing Skills in Egyptian Arabic Speaking Children with Specific Language Impairment: An Integrated Approach

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Abstract

Background: Central auditory processing disorder has been receiving a growing amount of attention because of the possible link between auditory processing disorders and learning disabilities in general and specific language impairment in particular. To date, there is limited research directly investigating the overlap in symptoms observed among children with central auditory processing disorder and children with specific language impairment.

Aim of Study: To compare central auditory processing skills and language assessment scores in a group of Arabic speaking children having Specific Language Impairment in order to reach a better understanding of the relationship between both disorders.

Patients and Methods: This study is conducted on 60 Arabic speaking children whom ages range from 5 to 8 years, divided into 2 equal groups; cases and controls. All children were subjected to a multi-disciplinary battery of assessments. The battery combined language assessment, cognitive assessment, series of auditory processing tasks and finally a parent rated questionnaire.

Results: Out of the 30 children diagnosed with specific language impairment, 27 showed significantly lower scores in all the 4 central auditory processing tests than that in the control group, however, all cases showed positive results in at least 3 of the tests.

Conclusion: Children with specific language impairment in the current study proved to have auditory processing deficits. Results of the study come to confirm the expected assumption that central auditory processing disorder coexists with Specific language impairment.

Key Words: *Central auditory processing disorder – Specific language impairment.*

Introduction

SPECIFIC Language Impairment (SLI), is a condition that is also known as language-learning impairment or developmental language disorder, belongs to the category of specific disorders where the language level observed is substantially below the nonverbal intellectual capacity. This limitation on language abilities cannot be explained by any obvious factor such as hearing impairment, low verbal intelligence, neurological damage or psychological problems. Thus, the criteria for SLI are primarily exclusionary [1].

On the other hand, Central Auditory Processing Disorder (CAPD), is an umbrella term used for defining different types of disorders that the process of comprehending perceived auditory information by the higher auditory centers located in the central auditory nervous system [2]. Children diagnosed with CAPD often experience numerous difficulties such as asking for repetitions, hyperactivity, poor memory, inability to remember any kind of verbal message; thus, affecting the individual's academic performance [3].

To date, there is limited research directly investigating the overlap in symptoms observed among children with CAPD and children with SLI. Also, there is deficiency of such studies in Arabic speaking children. Clinical commentaries in textbooks [4] and consensus statements [5] assume the validity of CAPD as a construct; however, researchers have noted that individuals with CAPD often present with language and/or reading deficits similar to those observed in individuals with SLI. As a result, the question of whether pediatric CAPD is an

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auditory modality specific difficulty or a broader processing problem remains [6].

Patients and Methods

This study was conducted on 60 Arabic speaking children, in the period between December 2015 and March 2018. Their age ranged from 5 to 8 years old. Children included in the study were selected from Kasr El-Aini Phoniatic Outpatient Clinic and mainstream nurseries or daycares and were divided into two groups; group A with diagnosed with SLI and the second; group B with normal language development.

Inclusion criteria:

Average intelligence (IQ 85-110) and delayed language development with at least one of the following; (A) The receptive language age score at least 6 months below the mental age or chronological age, whichever is lower; (B) A combined language score of at least 12 months below the mental age or chronological age; or (C) An expressive language age score that is at least 12 months below the mental age or chronological age.

Exclusion criteria:

No present or past history of peripheral hearing impairment or otitis media (active or recurrent), psychological disorders or neurological disorders.

All children underwent the following protocol of assessment:

- 1- Parent and child interview; for history taking and general and neurological examination.
- 2- Psychometric evaluation; using Stanford Binnet test (4th edition) [7]. It yields visual, verbal reasoning, quantitative and short-term memory.
- 3- Language assessment; using Modified PLS-4 (Preschool Language Scale) Arabic edition [8] to diagnose SLI and underlying language difficulties.
- 4- Questionnaire for central auditory abilities Arabic version [9]. The questionnaire was filled in by parents of the selected cases. It is a total of 25 yes or no questions and includes subjective assessment of six parts: Localization and identification, sustained and selective attention, audio-visual integration, memory, language and scholastic achievement. The questionnaire is used to cover most of the behavioral characteristics of CAPD.
- 5- Central auditory behavioral test battery; Children were individually tested in a quiet soundproof room with minimum acoustic disturbances. All

stimuli were delivered through headphones. The children were clearly instructed before testing and were reinstructed if got confused or lost concentration. Equipment included: Sound treated room IAC, model 2001-two channels audiometer; GSI 61, calibrated according to the ISO standards, TDH 39 headphones, bone vibrator radio ear B 71 were used. The central auditory behavioral test battery included four tests that were done for each child individually:

- Competing sentence test [10].
- Speech in noise test [10].
- Memory for sequence [11].
- Auditory fusion test [12].

Statistical analysis:

Numerical data were expressed as mean and standard deviation or median and range as appropriate. Qualitative data were expressed as frequency and percentage. Chi-square test or Fisher's exact test was used to examine the relation between independent qualitative variables. McNemar test was used to examine the relation between dependent qualitative variables. Agreement between different clinical tests was examined using kappa test. For quantitative variables, comparison between two groups was done using independent sample *t*-test or Mann-Whitney test as appropriate. Comparison of repeated measures was done using Wilcoxon signed-ranks test. Pearson product-moment or Spearman-rho method was used to estimate correlation between numerical variables as appropriate. All tests were two-tailed. A *p*-value <0.05 was considered significant.

Results

Results show that the cases and controls in this study were age matched as there was no significant difference in the age of the children selected. However, regarding the Intelligence Quotient (IQ), results show that significant difference was found when comparing the IQ of the study group to the control group.

There was significant difference between the two groups regarding the auditory comprehension standard score and language age, expressive communication standard score and language age and finally the total standard score and total language age.

Significant difference seen between the study group and control group regarding the results of the central auditory tests. As for the memory for sequence test, speech in noise test and competing sentence test values were significantly lower in

the study group compared to the control group, whereas, auditory fusion test values were significantly higher in the study group compared to the control group.

Results of the parental questionnaire shows that scores of all items of the questionnaire were significantly lower in the study group compared to the control group; however, for the localization and identification no significant difference was seen. The total score as well was significantly lower in the study group compared to the control group.

Results of the preschool language scale was correlated positively with memory for sequence test, speech in noise test, competing sentence test and negatively with auditory fusion test (1000 and 4000) with some variability between the total PLS score and its two subscales AC and EC.

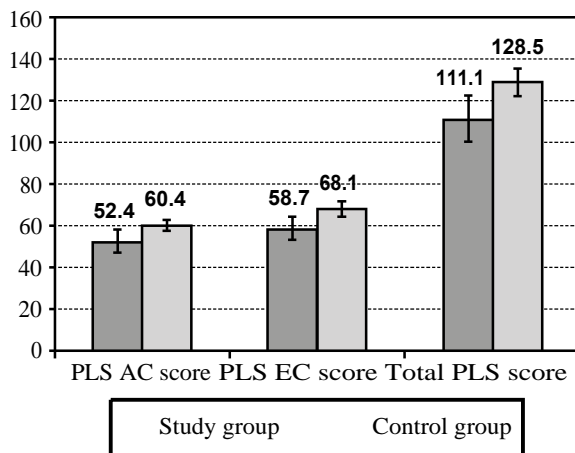


Fig. (1): Preschool Language Scale (PLS) scores and its subscales in the two studied groups.

PLS AC score: Auditory comprehension standard score.
 PLS EC score: Expressive communication standard score.

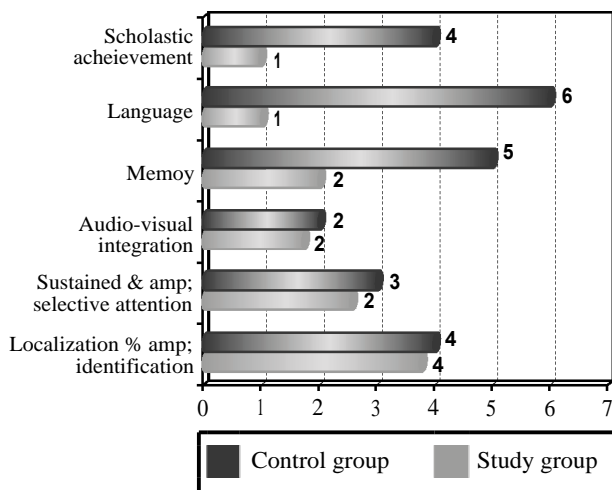


Fig. (2): Comparison of the parental questionnaire items results in the two studied groups.

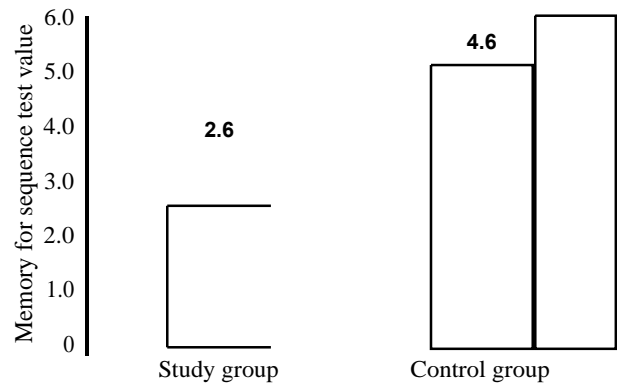


Fig. (3): Memory for sequence test results in the two studied groups.

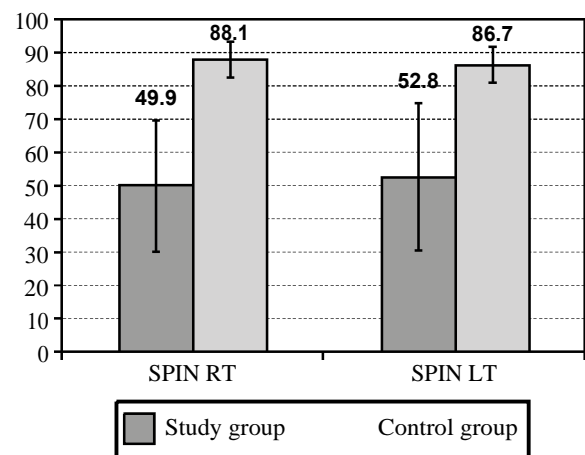


Fig. (4): Speech in noise test (right and left ears) results in the two studied groups.

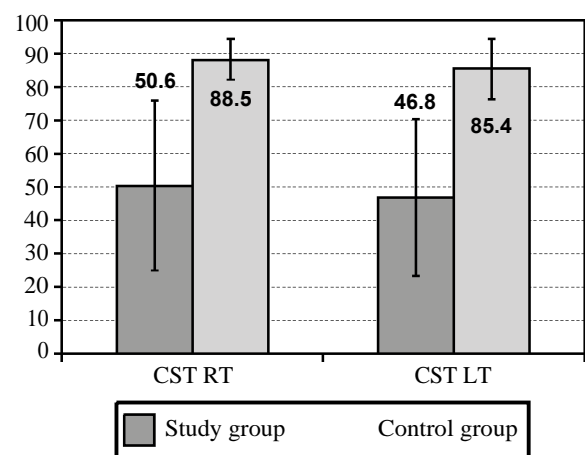


Fig. (5): Competing sentence test (right and left ears) results in the two studied groups.

Table (1): Comparison between the study group and control group regarding the intelligent quotient.

Group	Study group		Control group		p-value
	Mean	SD	Mean	SD	
Intelligence Quotient	91	6	101	7	<0.001

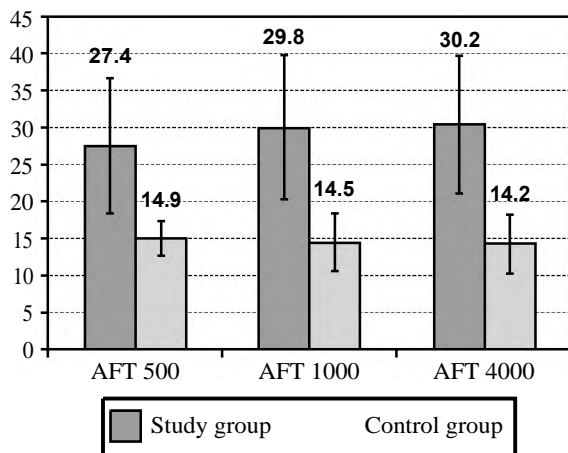


Fig. (6): Auditory fusion test (at 500, 1000 and 4000Hz) results in the two studied groups.

Table (2): Correlation between the preschool language scale 4 scores and the central auditory tests results in the study group.

	PLS AC		PLS EC		Total PLS	
	r	p	r	p	r	p
Memory sequence	0.565	0.001	0.600	0.001	0.620	<0.001
<i>Speech in noise:</i>						
• Right ear	0.294	0.122	0.444	0.016	0.396	0.034
• Left ear	0.138	0.475	0.172	0.372	0.166	0.391
<i>Competing sentence:</i>						
• Right ear	0.341	0.065	0.558	0.001	0.483	0.007
• Left ear	0.450	0.013	0.412	0.023	0.457	0.011
<i>Auditory fusion:</i>						
• 500Hz	-0.092	0.629	-0.010	0.959	-0.052	0.786
• 1000Hz	-0.514	0.004	-0.434	0.017	-0.502	0.005
• 4000Hz	-0.413	0.023	-0.312	0.094	-0.382	0.037

Discussion

The causal relationship between auditory processing and language impairment is still indefinite. Although the presence of alterations in auditory processing in individuals with SLI is supported by many studies, this theory is not universally accepted, since the results of some studies have failed to find evidence of changes in auditory processing in children with SLI and, consequently, the etiological causes of disorders in language development remains controversial. Thus, aiming to study this relationship, a battery of tests was designed in the present study to tackle every facet of it. The battery combined language assessment, cognitive assessment, series of auditory processing tasks including dichotic digit test, monaural low redundancy speech test, non-speech temporal resolution test and finally a parent rated questionnaire.

The results of this multi-disciplinary evaluation showed that the overall performance obtained by

SLI group was worse when compared to the typically developing group as seen in all the comparative studies. These findings are consistent with similar studies [13,14] that used a wide range of measures to compare the language, communication, and cognitive skills of children with SLI, children with CAPD, and a random sample of school children. The former two groups did not differ on tasks that measured auditory processing, grammar and vocabulary, motor speed, and parent-rated attentional functioning.

Although the IQ in the study group was considerably average, yet it was notable that the scores were lower than that of the control group. In comparison, some studies [15] have not found any cognitive deficits in SLI children, while others as [16] stated that children with SLI have been found to show deficits in several types of nonverbal tasks, and often score below age peers on nonverbal subscales of IQ tests. The contradictory results might be explained by the way cognitive abilities are assessed. Some studies used a more comprehensive battery to test cognitive abilities, as in the current study, the battery combined both verbal and non-verbal subtests of Stanford Binnet 4th edition.

As regards the central auditory processing tests, SLI children, showed difficulties in speech comprehension skills in conditions of degraded hearing (noise) in SPIN test, competitive speech in CST and difficulty in processing non-verbal stimuli (discrimination) in AFT test and verbal stimuli in memory for sequence that could result in difficulties in the accurate perception of speech and thus compromise the integrity of speech processing and production.

Out of the 30 children diagnosed with SLI, 27 showed significantly lower scores than that in the control group in all the 4 CAPD tests, however, all cases showed positive results in at least 3 of the tests which supports the idea that poor auditory processing ability is often present in children with SLI. On the other hand, the SLI children showing relatively good CAPD scores, support the claim that poor language can result from factors other than poor speech processing. Alternatively, poor speech processing abilities during early development may have resolved by the age at which the children were tested, specifically talking about the older age group. This might be due to full brain maturity or myelination in the older children. On another note, a very few children (2 out of 30) with typical language development showed a less than average score on only one of the CAPD tests,

in spite of good language, suggesting that, if poor central auditory processing measures indicate poor speech processing at some level, then there are somehow ways amending for the poor speech processing that results in good language abilities.

Although generally parental questionnaires or reports on one individual by another are always subject to several potential misconceptions, yet in this study results shows that subjectively, children with SLI do not have any difficulties regarding identifying the sound source or localizing it, functions that are more related to the well-being of the peripheral hearing system. However, it was notable that the lowest scores in the questionnaire regarding the SLI group were obtained in the attention and memory subdivisions, were scores were significantly lower in the SLI group than the control group. These results run along with those of the more objective CAPD tests.

Conclusion:

The results of the current study come to confirm the assumed hypothesis, indicating that changes in central auditory processing coexist in children with SLI and that the two disorders might not have a distinct clinical-behavioral profile.

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Nil.

Conflicts of interest:

There are no conflicts of interest.

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تقييم مهارات المعالجة السمعية فى الأطفال الذين يعانون من تأخر لغوى نوعى؛ نهج متكامل

إن فشل بعض الأطفال فى إتقان اللغة بالمعدل الطبيعى، على الرغم من الذكاء الجيد والتعليم الكافى، قد حير الباحثين لعدة عقود. هناك نظرية مقترحة هى أن ضعف اللغة النوعى فى الأطفال هو نتيجة المشاكل الإدراكية السمعية منخفضة المستوى. أجريت هذه الدراسة على ستين طفلاً يتحدثون اللغة العربية تراوحت أعمارهم بين خمس سنوات إلى ثمانية سنوات. تم تقسيم الأطفال إلى مجموعتين: مجموعة الدراسة مكونة من أطفال يعانون من ضعف لغوى نوعى ومجموعة المقارنة مكونة من أطفال ذوى تطور لغة طبيعى. تعرض جميع الأطفال لبطارية من الإختبارات بين تخصصات متعددة. البطارية تجمع تقييم للغة، تقييم للذكاء، وسلسلة من مهام معالجة السمعية المركزية وأخيراً إستبيان للأهل.

أثبتت نتائج البحث أن الأطفال ذوى التأخر اللغوى النوعى يعانون من ضعف فى قدرات السمع المركزى حيث أن نتائج أختبرات السمع المركزى المستخدمة فى البحث كانت أضعف فى أطفال مجموعة الدراسة بالمقارنة بأطفال مجموعة المقارنة مما يؤكد ترابط تأخر اللغة النوعى بإضطراب معالجة السمع المركزى عند الأطفال. أوضح البحث أيضاً، ضعف فى نتائج إختبارات الذاكرة العاملة المستخدمة فى الأطفال الذين يعانون من تأخر لغوى نوعى مما يوضح الترابط بين ضعف قدرات السمع المركزية وضعف الذاكرة العاملة عند هؤلاء الأطفال. وأخيراً أوضح البحث الترابط بين نتائج الإستبيان الخاص بالأهل عن حالة ذويهم ونتائج إختبارات، اللغة والسمع المركزى المستخدمة فى البحث.