The Egyptian Journal of Hospital Medicine (April 2018) Vol. 71 (6), Page 3424-3428

Phonological Awareness in Cochlear Implants Users

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ABSTRACT

Background: Phonological awareness (PA) refers to the explicit awareness of the abstract units that compose spoken words, including syllables, onset and rime units, and individual phonemes. Phonological awareness is a critical precursor to the acquisition of reading**.**

Objective: The aim of this work was to evaluate the phonological abilities skills in children with cochlear implant users (CI), and if they need interventionor not.

Subjects and Methods: We assessed PA using certain skills of the Arabic phonological awareness test (blending syllables into words (BSW), blending phonemes into words (BPW) and isolating initial sound (IIP). Thirty children with cochlear implant (CI) and control group of 25 normal developed children. Inclusion criteria: children aged from 5:8 years with IQ ≥ 80, and their language age at least 3-word sentence, Started basic literacy skills, and their mother tongue was Arabic language. Exclusion criteria: Mental retardation and any Neurological diseases. **Results and conclusion:** PA skills as regarding BSW, BPW is intact within the study group, while IIP was defective in CI users children, which need further training throughout their language therapy sessions.

Keywords: phonological awareness, cochlear implant, and learning problems.

INTRODUCTION

Phonological awareness refers to the explicit awareness of the abstract units that compose spoken words, including syllables, onset and rime units, and individual phonemes. Phonological awareness is a critical precursor to the acquisition of reading [(1)]**.** Reading is the process by which one constructs meaning from printed symbols. It is a language based activity; therefore deficits in oral language will be reflected by deficits in written language [(2)]**.** Phonological awareness is not a unitary skill. Words can be broken down into smaller units in at least three ways. The three phonological units that are most widely accepted include: syllabic, intra-syllabic, and phonemic. Understanding the phonological awareness development of these group is especially important because of the well-established relationship between early phonological awareness abilities and later reading abilities of children with normal development[(3& 4)].

The aim of this work was to evaluate the phonological abilities skills in children with cochlear implant users (CI), and if they need intervention or not.

SUBJECTS AND METHODS

This study included a total of thirty children with an age range of (5-8 years) with cochlear implant (CI) and control group of 25 normal developed children, attending at Phoniatric Department, Hearing and Speech Institute**,** Imbaba and Phoniatric Department, Faculty of Medicine, Ain Shams University. Approval of the ethical committee and a written informed consent from all the subjects were obtained. This study was conducted between (August 2015, and January 2018).

We assessed PA using certain skills of the Arabic phonological awareness test (blending syllables into words (BSW), blending phonemes into words (BPW) and isolating initial sound (IIP).

Inclusion criteria

Children age from 5:8 years, intelligent quotient (IQ) ≥ 80, their language age at least 3 word sentence, Started basic literacy skills, their mother tongue was Arabic, and all at the middle socioeconomic class.

Exclusion criteria

Mental retardation, neurological diseases, and any associated disorder with the specified condition.

Evaluation was carried out using the protocol of assessment followed at Phoniatric Unit, Ain Shams University: preliminary diagnostic procedures, clinical diagnostic aids, and additional instrumental measures. The skills blending syllables into words (BSW), blending phonemes into words (BPW), and isolating initial sound (IIP) have been selected from the list of Arabic phonological awareness test skills to be applied on children.

Statistical analysis

Categorical variables were described using counts and percentages and presented graphically through tables and bar charts. Statistical tests

Received:20 /3 /2018
Accepted:30 /3 /2018

DOI**: 10.12816/0047303**

included Chi Square, and Fisher's exact for categorical variables, P-values less than 0.05 were considered significant (all analyses were done using IBM SPSS v24).

RESULTS

1-Distribution of subjects according to gender: Males constituted 52.7% of the whole sample size and 47.3% were females. Males constituted 48% of the control group, and 56.7% of the cochlear implant group (table 1- figure 1). The difference in gender distribution between groups was not significant by chi square test (p= 0.593), (P-value less than 0.05 was considered significant).

Table (1): Distribution of subjects according to gender

			Gender		Total
			male	**female**	
Group	**Normal**	**Count**	12_a	13_a	25
		% within Group	48.0%	52.0%	100.0%
	Cochlear Implant	**Count**	17_a	13_a	30
		% within Group	56.7%	43.3%	100.0%
Total		**Count**	29	26	55
		% within Group	52.7%	47.3%	100.0%

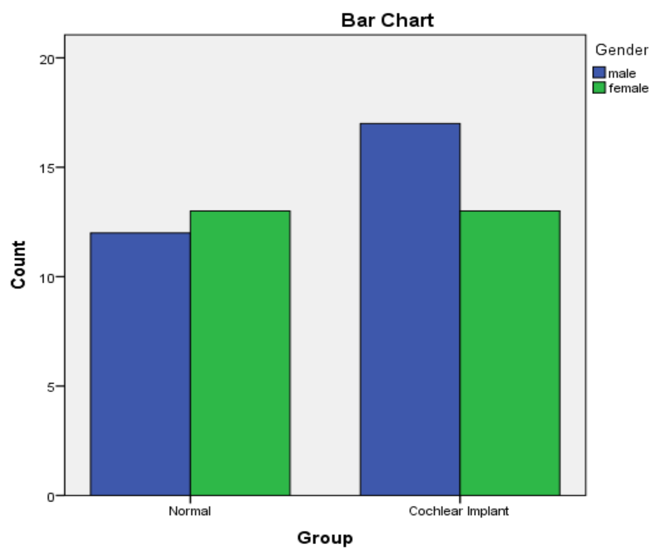

Figure (1): showing gender distribution within the groups

2-Comparison between CI children results and normal subjects in different skills: By Fisher´s exact test, there was non-significant difference between both groups as regards the BSW scores (p = 0.242) (table 2), and BPW scores (p = 0.117) (table 3), but there was a significant difference between both groups for the IIP scores (p = 0.002) (table 4).

Table (2): BSW results within CI & normal

			BSW score status		Total
			Adequate score	**Inadequate score**	
Group	**Normal**	**Count**	25	0	25
		% within Group	100.0%	0.0%	100.0%
	Cochlear Implant	**Count**	27	3	30
		% within Group	90.0%	10.0%	100.0%
Total		**Count**	52	3	55
		% within Group	94.5%	5.5%	100.0%

p = 0.242 (NS)

Table (3): BPW results within CI & normal

			BPW score status		Total
			Adequate score	Inadequate score	
Group	Normal	Count	25	0	25
		% within Group	100.0%	0.0%	100.0%
	Cochlear Implant	Count	26	4	30
		% within Group	86.7%	13.3%	100.0%
Total		Count	51	4	55
		% within Group	92.7%	7.3%	100.0%

p = 0.117 (NS)

Table (4): IIP results within CI & normal

			IIP score status		Total
			Adequate score	Inadequate score	
Group	Normal	Count	23	2	25
		% within Group	92.0%	8.0%	100.0%
	Cochlear Implant	Count	16	14	30
		% within Group	53.3%	46.7%	100.0%
Total		Count	39	16	55
		% within Group	70.9%	29.1%	100.0%

p = 0.002 (S)

DISCUSSION

This study was designed to evaluate whether the speech perception benefits offered by cochlear implantation affect the development of phonological awareness in children and consequently support their reading development or not. Except for the task of IIP, profoundly deaf children with CIs were found to have developed fairly adequate levels of phonological awareness comparable with normal children, suggesting an evidence for benefit from their CI.

Understanding the phonological awareness development of these groups is especially important because of the well-established relationship between early phonological awareness abilities and later reading abilities of children with normal development. Understanding those factors that may explain the variance in phonological awareness for children with cochlear implants at an early stage may enable these children to avoid the plateau in reading skills that usually occurs for children with such problems. It may also increase the numbers of children who reach optimum levels of literacy.

In this study, only three PA tasks were chosen to be applied. Excluding the rest of the tasks was important to avoid any result bias from misunderstanding of the task itself due to the under-developed language of the children. Our results revealed that there was no significant difference between both groups (CI and control) regarding BSW and BPW items of the phonological awareness test. However, there was a significant difference between both groups in IIP. In general, this result could be explained by one of the more than one possibility. The isolation task is naturally a difficult task that normally develops in older ages. In addition, exposure to orthographic presentation of phonemes in literacy may be delayed in this population due to their delayed exposure to hearing and consequently delayed language development.

Although that by definition, awareness should be all-or- none aptitude, children's performance on different phonological awareness tests varied considerably. For example, preschool children are relatively successful in rhyme detection tasks, can accurately count the number of syllables in words but they cannot isolate single phonemes. The "all-or-none" view of awareness and the differences in performing tests of phonological awareness can be reconciled by assuming that phonological awareness is a heterogenic metalinguistic competence including abilities which differ in developmental trends and origins [5].

The isolation task is a difficult more advanced skill which needs a high quality phonological presentation in the brain to be easily separated from the acoustic effect of the neighboring phonemes.

Another explanation that PA develop in gradual manner from the easier to the most difficult, so when a young children been tested he failed in advanced tasks.

Yopp's study [(6)] revealed that phonemic segmentation, sound isolation, and phoneme counting are the most difficult categories in the test which have a greater burden on short-term memory than others. Most Studies of phonological awareness showed that most preschool children can segment words into syllables but cannot manipulate or isolate single phonemes. A possible explanation is that phonological awareness is a gradually developing ability, or that there are "levels" of phonological awareness. However, it is also possible that there is a qualitative distinction between the awareness of single phonemes and the awareness of multi-phonemic structures which accounts for the observed difference in performance with phonemic segmentation. In other words, it is possible that awareness and manipulation of single phonemes and detection and sensitivity to syllabic or intra-syllabic structures are qualitatively different forms of phonological awareness rather than two levels along a continuum of one ability. A consequence of the process of co-articulation that characterizes speech production, the sound frequency patterns forming acoustic segments in speech reflect the combined continuation of several complex gestures, each intended to produce a different phone. Moreover, because a phone is usually co-articulated with different phonetic contexts, there can be no direct correspondence in segmentation between the acoustic signal and the phonetic message it conveys. Therefore, Speech perception cannot be based on a simple translation from a set of auditory representations to a set of perceptual phonetic categories. Consequently, Awareness of each of the phonemes conveyed by one acoustic segment probably follows a more basic and automatic process of phonetic deciphering. This is probably why, although phonetic distinctions in speech are easy and natural, awareness of phonetic categories appears much later in ontogenetic development and probably requires more than simple cognitive maturation. This awareness require the ability to break up the co-articulated phonological segments and isolate their individual phonemic constituents [(5)].

Second is exposure to the orthographic presentation of phonemes in literacy, which is suggested to have a strong effect. The child is exposed to phonological skills with different modalities including intensive visual presentation which in-turn mark the phoneme in child´s PA skills development. As when the children were exposed more to literal education they perform better in isolation task. In support to our view we found many researches. Learning to read affects PA; it was found that Chinese children who learned to use alphabetic reading have more developed PA than who use logographic reading [(7)]. ***Man study*** [(8)] found the same results in Japanese children. Also illiterate adults perform very poor on tests of phoneme isolation and manipulation [(9, 10)]. The results of the ***Bentin study*** [(11)] study pointed to schooling (learning to read) as a major factor affecting the development of phonological awareness. In summary, the development of the early phonological awareness (detect and produce rhymes and the sensitivity to sub-syllabic segments, differ from that of the phonemic awareness (isolate and manipulate individual phonemes in speech). The first appears to emerge almost automatically and instantaneously in the majority of children when they are first exposed to nursery rhymes or other forms of phonological word games and develops independently of reading instruction. On the other hand, the second is triggered in most children when understanding the alphabetic principle during acquisition of reading in an alphabetic orthography.

Third is the original problem this population has. The delayed language development problem affect their cognition and response for test tasks. The non-phonological language skills encompass performance in tests of syntax, morphology and vocabulary, both receptive and productive. It may be contributed to a comprehension problem which could be over-come by delaying their entrance to school to give them a chance to improve their language and their cognition. In addition to their limited lexicon, the working memory play an important role which in turn affects PA abilities. Also the age of implant and the adequacy and frequency of language training is an important factor to such skills.

In support to our study, ***Sophie study*** [(12)] did a study in which twenty four children (36: 60 months of age) who were wearing their cochlear Implant at least 18 months (CI group) and 26 normal hearing (NH group) and phonological awareness was assessed (blending and deletion tasks). Non-significant difference was found between the NH group and the CI group on blending syllables and phonemes. However, a significant difference was in deletion task.

In contrast, ***Kyritsia study*** [(13)] studied two groups of deaf children; one group was at the nursery school (13 children) and one group was at the primary school (11 children). Seventeen children were hearing aid users and seven were cochlear implant users. All children used oral speech. Phonological awareness was assessed at the levels of syllable, rhyme and phoneme. The deaf groups scored higher on the syllable task than on the rhyme and phoneme tasks. Further, the preschoolers performed the same on the rhyme task and on the phoneme task whereas the primary school children performed better on the phoneme task than on the rhyme task. Both hearing groups scored higher on the syllable task than on the rhyme task and they gave a higher score on the rhyme task than on the phoneme task. In deaf children phonological awareness does not develop 'automatically' by a particularly age, like in typically developing hearing children. In addition, as the comparison of the two deaf groups showed, literacy acquisition seems to be a factor in the development of phonological awareness even at the syllabic level. It appears that reading development and orthographic knowledge form a basis on which deaf children can draw conclusions about spoken words and their written representations [13].

Kyritsi study [13] said that the development of phonological awareness progresses from syllabic awareness to intra-syllabic awareness then the phonemic awareness. It was predicted that the same would happen in her study. Both hearing groups scored higher on the syllable task. Poorest score was on the phoneme task. The fact that the Greek deaf children, in contrast to English deaf children, performed better on the phoneme task than on the rhyme task could be attributed to the one-to-one mapping between graphemes and phonemes for reading in Greek. Also speech and language therapists in Greek typically train beginning deaf readers on individual letters and on identifying these letters within words. Training usually starts by identifying letters that occur at the beginning of a word. If a deaf child is presented with a letter and with a word beginning with that letter, the child will begin to grow that skill gradually. So, literacy acquisition is a particularly factor in the development of phonological awareness even at the syllabic level.

CONCLUSION

CI children have defective IIP task in PA which requires more training. Also phonological awareness is a low moderate predictor of reading development in children with hearing loss, so clinicians have to continue working on that skill with these children but they also should target other skills that are precursors of reading. Language skills were more predictive of reading development in children with hearing loss than phonological awareness skills. Clinicians should focus on core language skills (vocabulary, receptive language and expressive language) in order to support the acquisition of early literacy skills and phonological awareness skills. Also speech reading may have effect on phonological awareness and early word reading.

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