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ORIGINAL ARTICLE

Development of a remediation program for Egyptian dyslexic children

Yehia Amin Aboras [a], **Manal Mohamed Elbanna** [a], **Rania Mohamed Abdou** [a,*], **Hoda Mohamed Salama** [b]

[a] Unit of Phoniatrics, Ear Nose and Throat Department, Alexandria University, Egypt
[b] Unit of Psychiatry, Neuropsychiatry Department, Faculty of Medicine, Alexandria, Egypt

Abstract *Objectives:* The present study was designed to formulate a remediation program for Arabic speaking children suffering from dyslexia based on improving phonological awareness using materials appropriate for Arabic culture.

Methods: The study was carried out at the unit of Phoniatrics, Faculty of Medicine, Alexandria main university hospital. The subjects were divided into two groups. Group I: 30 dyslexic children of both sexes in the age range of 6½–10½ years on which the proposed remediation programme was applied. Group II: 30 dyslexic children age and sex matched were included as a control group; they received no remediation programs during the time of conduction of the study. The formulated Arabic remediation program was based on improving the phonological awareness for dyslexic children, after the Phonological Awareness Training for Reading Program. Modifications and additions were made to suit the nature of the Arabic language, and face the differences between Arabic and English orthography. The program was divided into sound blending, sound segmenting, reading and spelling activities. The training program was applied twice weekly, with session duration lasting from 25 to 30 min. Each session had about 2 or 3 children. The studied groups were subjected to protocol for evaluation of dyslexia before and after therapy to document to evaluate the improvement and the stability in the condition of these children.

Results: The presented training program significantly improved reading, writing and phonological awareness of dyslexic cases.

Conclusion: The present study highlighted the importance of phonological awareness skills as a prerequisite for emergence of literacy skills. The program was modified to suit Arabic speaking Egyptian children. The study found that the age of the child is the most important predictor factor, the younger the age of intervention the better the outcome of therapy program.

1. Introduction

Developmental dyslexia is defined as an unexpected difficulty in reading in children and adults who otherwise possess the intelligence and motivation considered necessary for accurate and fluent reading and who also have had reasonable reading instruction. It has a prevalence estimated between 5 and 10%.[1] Many theories have been postulated aiming to highlight the etiological basis of dyslexia, the most developed and supported theory for dyslexia is the phonological deficit theory. An emerging consensus is that developmental dyslexia is characterized by difficulties in language processing. These difficulties are primarily at the level of phonological processing of speech sounds, specifically phonological awareness, which is the ability to recognize and manipulate the sound structure of words.[2]

Children with dyslexia do not easily acquire the basic phonologic skills that serve as a prerequisite to reading; consequently, management of dyslexia demands explicit teaching of concepts such as phoneme awareness. Operationally, this is accomplished with systematic and highly structured training exercises.[3]

There is a need to develop an Arabic remediation program as the Arabic language differs from western languages in many aspects, the most important of which are: (a) unlike western languages Arabic is written from right to left; (b) Arabic is always written in script form (with letters joined), whereas the letters may be separated (in block) in western languages; and (c) Arabic alphabets do not contain directionally confusing letters such as b–d, p–q, n–u, and w–m.[4]

Most Arabic letters have more than one written form, depending on the letter's place in a word: beginning, middle or end. However, the essential shape of the letter is maintained in all cases.[5] In addition, the letters are divided into categories according to basic letter shapes, and the difference between them is the number of dots on, in or under the letter. Dots appear with 15 letters, of which 10 have one dot, 3 have two dots and 2 have three dots. In addition to the dots, there are diacritical marks that contribute phonology to the Arabic alphabet.[6] Arabic words are a combination of consonants and vowels.

The Arabic script is fairly unusual in its transparency, transparency here refers to the association between written symbols and language sounds. A transparent script has a simple one-to-one relationship, whereas less transparent scripts, such as English, have a much more complex relationship between letters and sounds. The use of diacritical markers in beginning readers' texts makes the script highly transparent (texts that include diacritics that represent short vowel are referred to as vowelised texts). However, these short vowel markers are absent in the majority of more advanced written works (i.e., nonvowelised texts), which produces a highly opaque script with a large number of homographs that can only be pronounced correctly through an appreciation of the context within which they are written. Once the readers have progressed beyond first- or second-grade texts, therefore, they would be expected to be able to process non-vowelised (highly opaque) text.[7]

The impact of phonological processes on literacy acquisition in Arabic learning has been studied in Bahraini children and the results indicated the potential importance of phonological processes as predictors of early literacy in this cohort of Arabic-speaking children.[8] Remediation of dyslexia when emphasizing the role of phonological awareness training programs will have a beneficial impact on the reading skills of dyslexic children. There has been a defect in the remediation programs of children with the Arabic language as their native language.

2. Aim of the study

The present study aimed to design, formulate and evaluate a remediation program of intervention for dyslexic children based on improving phonological awareness using materials appropriate for Arabic speaking children.

3. Subjects

The subjects in this study were divided into two groups: Group I: A group of 30 dyslexic children of both sexes in the age range of 6½–10½ years enrolled in the grades of elementary schools, recruited from cases attending the unit of Phoniatrics, Faculty of Medicine, Alexandria University. Only after obtaining a full informed consent from both (or the attending) parent(s), as well as the approval of the ethics committee of the Faculty of Medicine, Alexandria University, the proposed remediation program was applied on this group. Exclusion criteria included learning difficulties due to mental subnormality, associated attention deficit hyperactivity disorder, hearing impairments and central auditory processing disorders.

Group II: Another group of 30 dyslexic children age and sex matched were included as a control group; they received no remediation programs during the time of conduction of the study, this was either due to refusal of parents to attend therapy sessions during the school year, or due to long distance and inability to attend sessions during winter.

4. Methods

4.1. The steps of the study proceeded as follows

4.1.1. Formulation of the remediation program in Arabic language

This program was based on improving the phonological awareness for dyslexic children, after the Phonological Awareness

Table 1 Distribution of age group in the two studied groups.

Age group	Group I "$n = 30$"		Group II "$n = 30$"	
	No.	%	No.	%
6.6–7.5 years	7	23.3	8	26.7
7.6–8.5 years	10	33.3	8	26.7
8.6–9.5 years	7	23.3	9	30.0
9.6–10.6 years	6	20.0	5	16.7
Total	30	100.0	30	100.0
X^2 (P)	1.26 (0.97)			

Training for Reading Program.[9] Some modifications were made, and some steps were added to the program to suit the nature of the Arabic language, and to face the differences between Arabic and English orthography. The program included rhyming activities to help children focus their attention on the sounds in words, followed by sound blending activities where children started the formal training program with activities that teach them to blend individual sounds to make words. These were followed by Sound segmenting: activities. In the final phase of instruction, children were taught how to use their phonological awareness skills in reading and spelling.

Each patient was subjected to the thorough evaluation for identification of children with attention deficit hyperactivity disorder, neurotic traits, mood disorders, aggression, impulsivity and depression for exclusion. Psychometric evaluation were included: Stanford Binet test: to assess intelligence quotient (IQ) and mental age,[10] and Wechsler Intelligence scale for children was also performed.[11] Language assessment was formally conducted using Arabic language test.[12] Evaluation of dyslexia using the Arabic dyslexia assessment test.[13] for determination of weaknesses and strengths in the child's performance. Ophthalmologic evaluation: to exclude visual impairments. Audiological assessment was performed to exclude hearing impairment and central auditory processing problems.

4.1.2. Application of the training program
The training program was applied to group I. subjects they attended the training sessions twice weekly, with session duration lasting from 25 to 30 min. Each session had about 2 or 3 children who were age and performance matched.

4.1.3. To reevaluate dyslexia in both groups post therapy
The initial protocol for evaluation of dyslexia was applied after therapy for both groups, and also one year after therapy to group I to evaluate the improvement and the stability in the condition of these children.

5. Statistical analysis

Statistical analysis was done using Statistical Package for Social Sciences (SPSS/version 15) software and the mean ($\bar{x}$), standard deviation (SD), student t-test and (ANOVA) or (F-test) were computed, also Duncan's new multiple range test (MRT) was used to compare sets of means.

6. Results

Table 1 shows the age distribution in both group I and group II, they were distributed into 4 age groups in each group. There was no significant difference between both groups regarding age group distribution (Table 1) ($p = 0.97$). Males accounted for almost 70% in both groups. There was no significant difference between them ($p = 0.48$).

6.1. Results of the Arabic dyslexia assessment test

The cases completed the therapy program in a duration that lasted from 32 to 39 sessions with a mean of 34.83 + 2.437. (About 17.4 + 1.2 weeks).

The performance of the children on Arabic dyslexia test of group I at pre and post therapy and after a one year period was shown in Figs. 1–4.

Improvement in performance was noticed after therapy in the first 3 age levels; except the oldest age group; and it continued throughout the year as regards one minute reading, two minute spelling, phonemic segmentation and nonsense passage reading whereby there was stabilization or very mild change in the performance in the rest of items.

NB: In all graphs the rapid naming item was divided by ten to show the differences between the rest of the items.

iv- Evaluation of group II using the Arabic dyslexia assessment on initial evaluation and after the therapy duration (4.2 months) (Fig. 5), revealed no significant difference between the different test items on initial evaluation and after at follow up in the control group at all age groups.

iii- At Risk Index ARI of group I and II: (Tables 2 and 3)

There was a highly significant difference between the ARI results pre therapy post therapy but there was no significant difference between the results of ARI post therapy and
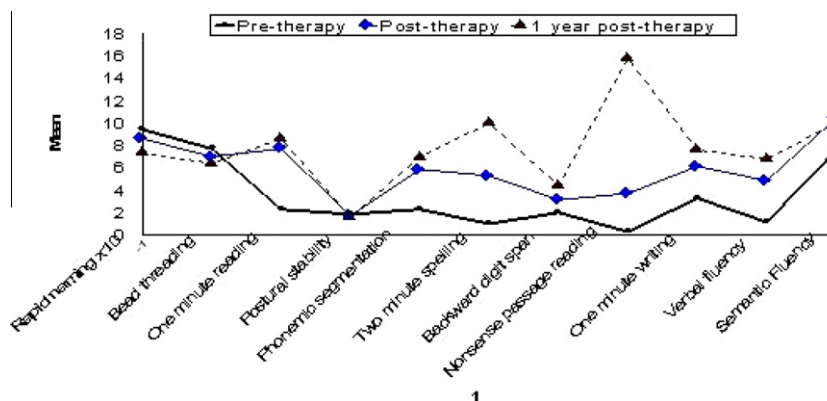

Figure 1 Comparison between different studied parameters pre therapy, post therapy and 1 year post therapy in group I.

Figure 2 Comparison between different studied parameters pre therapy, post therapy and 1 year post therapy in group I.
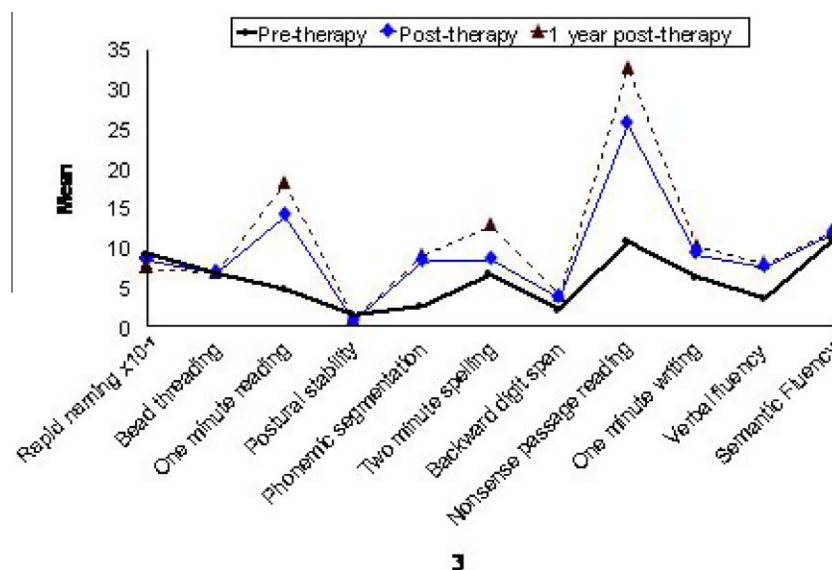
Figure 3 Comparison between different studied parameters pre therapy, post therapy and 1 year post therapy in group I.
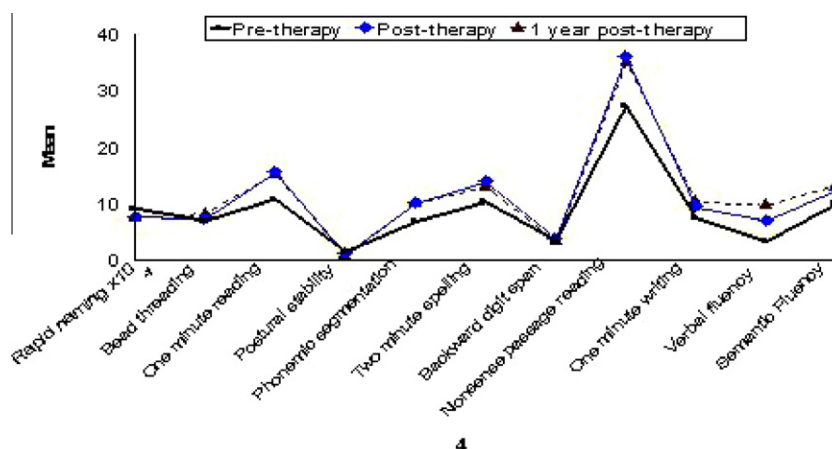
Figure 4 Comparison between different studied parameters pre therapy, post therapy and 1 year post therapy in group I.
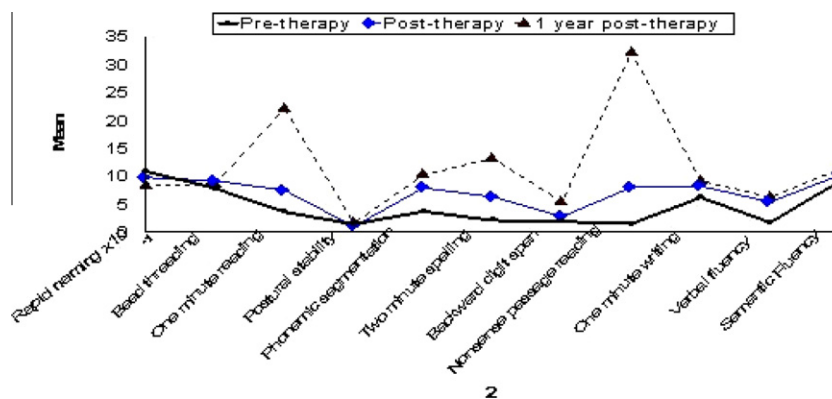
1 year post therapy ($p = 0.0013^*$). There was no significant difference between the at risk index (ARI) on initial evalua- tion and after the duration of therapy in group II ($p = 0.23$).

vi- Comparison between group I and group II after the duration of therapy regarding all test items of Arabic dyslexia assessment test and the ARI: (Table 4) There was a highly significant difference between group I and group II after the duration of therapy regarding all test items of Arabic dyslexia assessment test and the ARI.

Figure 5 Comparison between different studied parameter pre and at end of the period of program in group II.

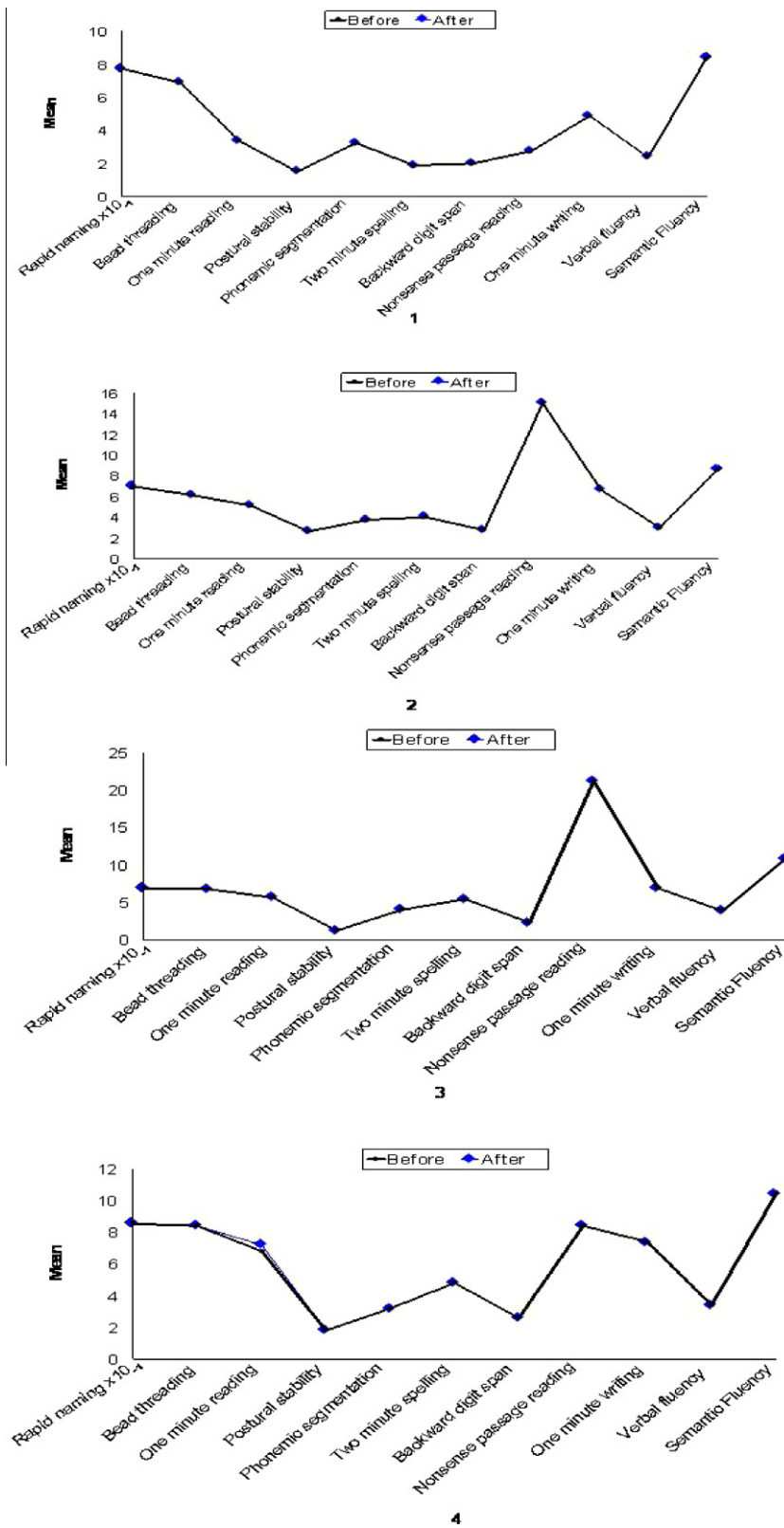**Table 2** ARI in group I at different period of follow up.

	Pre therapy	Post therapy	1 year post therapy
Min.	1.10	.60	.40
Max.	2.70	1.30	1.30
Mean	1.8900	.8267	.6958
S.D.	.43735	.14606	.21765
F	0.0013[*]		
p			

[*] P < 0.05.

Table 3 ARI in group II at different periods of follow up.

	Initial evaluation	After therapy duration
Min.	1.10	1.00
Max.	2.50	2.40
Mean.	1.7900	1.7333
S.D.	.36611	.41301
P	0.23	

7. Discussion

The increased awareness of the impact of Dyslexia on children and their scholastic achievements and consequently on their parents, and the limited resources regarding the therapy of Arabic speaking dyslexic children shed the light on the importance of the development of a structured training program for these children. The training program presented in this study was derived from the phonological awareness training for reading program.[9] This program was based on the work of several studies that have demonstrated that training children in phonological awareness has a beneficial impact on their reading skills. Previous studies proved that training in phonological awareness helps developing reading and spelling skills.[14,15]

The activities in this training program were arranged in a hierarchy from simple tasks to more complex ones and consisted of both analytic and synthetic phonological skills to give better impact on reading skills.[16] Because blending skills are much easier to train than analytic skills. The blending skills preceded analytic skills in the presented training program.

There was no need to train all 28 Arabic phonemes. Training in phoneme identity using a relatively small group of phonemes produced substantial increases in performance on tasks using phonemes that had not been trained and thus children can acquire a general understanding of the phonological structure of words.[17] The National Reading Panel recommended that the reading intervention programs should provide instruction as phonemic awareness, phonics, reading fluency, vocabulary, and reading comprehension strategies.[18] Teaching children to manipulate phonemes with letters; focusing the instruction on one or two types of phoneme manipulations rather than multiple types; teaching children in small groups; and providing explicit instruction that directly teaches children how to identify, count, and manipulate the sounds in spoken words were guidelines to follow in setting the therapy sessions.

Teaching reading includes teaching the reader to understand how letters are linked to sounds (phonemes) to form letter–sound correspondences and spelling patterns. In the present study children used letters to represent the sounds in words and associate a small set of phonemes with the letters that represent them. This systematic phonics program should be implemented in these early grades.[19] There is evidence that kindergarten-age children who receive phonics instruction benefit in their ability to read and spell words and comprehend text. Older children in later primary grades receiving phonics instruction are better able to decode and spell words and to read text orally, but their comprehension of text is not significantly improved.[20]

While important, phonemic awareness is not the only prerequisite to growth in reading skill.[21] Phonemic awareness and letter–sound knowledge are needed in combination to promote the acquisition of reading skill[22,23] and are both the most powerful predictors of early single word reading skill.[20]

Reading fluency although of critical importance because text reading that is dysfluent is slow and may impair the child's ability to comprehend, is often neglected in the classroom. The most effective method to build reading fluency is guided oral reading, i.e., reading aloud repeatedly to a teacher, an adult, or a peer, and then receiving feedback.[18] The presented training program included some training tasks that gave positive impact on word recognition, fluency, and comprehension at a variety of grade levels.

Researchers found that the effects of phonemic awareness instruction improved when combined with reading instruction[24] and spelling activities.[25] As interventions for reading comprehension are not well established and were not part of the program, dyslexic cases involved in our study (especially the fourth age group 9.6–10.6 years old) maintained their outcome and showed no significant difference comparing their results post therapy and one year post therapy. In general, the evidence suggests that teaching a combination of reading comprehension techniques is the most effective. When students use them appropriately, they assist in recall, question answering, question generation, and summarization of texts. When used in combination, these techniques can improve results in standardized comprehension tests.[18]

The current study showed a significant difference between group I and group II in all test items of the Arabic dyslexia assessment test and the at risk index (ARI). There was a significant difference between the scores of the group I pre therapy and post therapy in all test items of the Arabic dyslexia assessment test and the ARI. The difference between the scores of group I pre therapy and post therapy was more marked in younger age groups. One year post therapy the evaluation of the dyslexic children in group I revealed that the results of the first three age groups showed significant difference between the evaluation post therapy and 1 year post therapy, which almost coincides with the suggestion that if reading difficulties are recognized very early, they may be prevented,[26–29] while remediation of reading problems becomes increasingly difficult after the third grade.[30,31] In older children (group four), there was no significant difference between the results of all test items of the Arabic dyslexia assessment test and the ARI post therapy and 1 year post therapy. Some longitudinal studies indicate that dyslexia is a persistent, chronic condition; it does not represent a transient "developmental lag over time" and that poor readers and good readers tend to maintain their relative positions along the spectrum of reading ability.[32–34]

Several studies mentioned that deficits in phonological coding continue to characterize dyslexic readers even in

Table 4 Comparison between group I and group II after the duration of therapy regarding all test items of Arabic dyslexia assessment test and the ARI.

		Group I "$n = 30$"	Group II "$n = 30$"	p
1	Rapid naming mean ± SD	87.5000 ± 20.92804	73.7667 ± 23.07511	0.0032[*]
2	Bead threading mean ± SD.	7.7333 ± 2.86397	6.8667 ± 2.35962	0.033[*]
3	One minute reading mean ± SD	10.6333 ± 4.59748	5.1667 ± 4.02649	0.0021[*]
4	Postural stability mean ± SD	1.1000 ± 1.09387	1.8621 ± 1.27403	0.042[*]
5	Phonemic segmentation mean ± SD	7.9000 ± 1.86344	3.6667 ± 1.89979	0.001[*]
6	Two minute spelling mean ± SD	8.0667 ± 3.85901	4.1667 ± 3.92238	0.001[*]
7	Backward digit span mean ± SD	3.2667 ± 0.69149	2.5333 ± 1.52527	0.0215[*]
8	Nonsense passage reading mean ± SD.	16.6667 ± 18.68308	12.5333 ± 13.24239	0.003[*]
9	One minute writing mean ± SD	8.1333 ± 2.40306	6.4333 ± 2.77530	0.035[*]
10	Verbal fluency mean ± SD	6.0667 ± 1.79911	3.2667 ± 1.59597	0.0001[*]
11	Semantic Fluency mean ± SD	11.0333 ± 1.24522	9.6000 ± 1.81184	0.0025[*]
	ARI mean ± SD	.8267 ± .14606	1.7333 ± 0.41301	0.0001[*]

[*] $P < 0.05$.

adolescence; performance on phonological processing measures contributes most to discriminating dyslexic and average adolescent readers, and average and superior readers as well. Children with dyslexia neither spontaneously remit nor do they demonstrate a lag mechanism for "catching up" in the development of reading skills.[35] As children approach adolescence, a manifestation of dyslexia may be a very slow reading rate they may learn to read words accurately, but they will not be fluent or automatic, reflecting the lingering effects of a phonologic deficit.[36]

In the present study there was a significant difference between the scores of group I pre therapy and post therapy regarding the Phonemic segmentation, Two minute spelling, Nonsense passage reading, One minute reading, and One minute writing tasks. This goes hand in hand with the work of Hecht et al. (2002)[37] who proposed that relations between phonemic awareness and spelling skills are bidirectional. The amount of exposure that children had to the treatment intervention contributed uniquely to individual differences in posttest levels of phonemic awareness and spelling.

The present study showed a significant difference between the results of the rapid naming test item between group I pre therapy, post therapy in older children and pre therapy and 1 year post therapy in younger children. This coincides with the work of Vaessen et al. (2009)[38] whose study stated that there was no support for the existence of a second independent core naming deficit in dyslexia and indicate that speeded naming tasks are mainly phonological processing speed tasks with an important addition: fast cross-modal matching of visual symbols and phonological codes. This was based on three main findings, these are (a) naming speed was consistently related only to reading speed; (b) phonological processing speed and naming speed loaded on the same factor, and this factor contributed strongly to reading speed; and (c) although general processing speed was involved in speeded naming of visual items, it did not explain the relationship between naming speed and reading speed. This contradicts with the double deficit hypothesis which states that naming speed problems represent a second core deficit in dyslexia independent from a phonological deficit.[39,40]

8. Conclusion

In the present study we highlighted the importance of phonological awareness skills as a prerequisite for the emergence of literacy skills. The presented training program for dyslexic children was highly structured following the recommendations of the National Reading Panel and modified to suit Arabic speaking Egyptian children. The presented training program significantly improved reading, writing and phonological awareness of dyslexic cases.

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