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# Rapid automatized naming assessment in Egyptian children with attention-deficit/hyperactivity disorder

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## Abstract

**Background:** Millions of children around the whole world are diagnosed with attention-deficit/hyperactivity disorder (ADHD) which is considered as one of the most common mental disorders and often persists into adulthood. There is almost a weak point in rapid naming abilities in children with ADHD in comparison to children without ADHD.

This was a cross-sectional study that was applied on 30 patients with an age ranging from 8 to 11 years and 6 months diagnosed as ADHD based on objective and clinical examination and measures.

**Results:** After the application of the Rapid Automatized Naming test (RAN) test on 30 patients with ADHD, there were 24 cases out of the 30 cases (80%) below 25th percentile (at risk) and 6 cases out of the 30 cases (20%) at 25th percentile (average performance). As regard the accuracy of RAN, there were 10 cases (33.3%) below 25th percentile (at risk) and 20 cases (66.7%) at 25th percentile (average performance).

**Conclusions:** This study showed that among children with attention deficit hyperactivity disorder (ADHD), there was affection in Rapid Automatized Naming (RAN) duration which represents working memory affection relative to children without ADHD.

**Keywords:** Attention-deficit/hyperactivity disorder, Children, Rapid Automatized Naming

## Background

About 8.4% of children and 2.5% of adults are diagnosed with attention-deficit/hyperactivity disorder (ADHD) by symptoms of inattention (failure to keep concentration), hyperactivity (an excess movement which is not appropriate to the setting), and/or impulsivity (impulsive actions without thought) [1].

According to inattention and hyperactivity-impulsivity symptoms, ADHD could be divided into three subtypes: type ADHD-H which is mainly hyperactive-impulsive, type ADHD-I which is mainly inattentive, and combined type ADHD-C [2].

Rapid automatizing naming (RAN) is defined as the recognition of a given object, which is stored in the semantics vocabulary, retrieval, and uttering its name [3].

RAN tasks depend on the automaticity of each component of the naming circuit. This process predicts the ability of the child to link between the letters sequences and their linguistics information, which predict their reading abilities.

According to the speed and accuracy of RAN tasks, the response could be “rapid- accurate,” “rapid-inaccurate,” “slow-accurate,” or “slow-inaccurate” [4].

There are integration and organization of a wide range of processes which are required to complete the RAN task, and these processes include (I) attentional procedures to the triggering object, (II) visual processes with bihemispheric representation which is responsible for identification and pattern discrimination, (III) connection

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of visual information with the already stored orthographic representations, (IV) stored phonological representations are integrated with visual and orthographic information, (V) phonological information retrieval, (VI) connection between semantic and their meaning (conceptual information) with all other input, and (VII) speech through activation of articulatory muscles [4].

Although slow cognitive speed is not a direct cause of ADHD, but still, it is a critical part of the neuropsychological model of ADHD [5].

### Aim of the work

The present study aims to assess the rapid automatized naming deficits (in speed and accuracy) in cases of ADHD to investigate other cognitive deficits related to ADHD to be incorporated in management plan if proved.

## Methods

### Study design

This study was a cross-sectional study (pilot study). This study was applied on 30 patients complaining of ADHD symptoms, attending at the phoniatics outpatient clinic at the period from June 2019 to December 2020.

### Subjects

Thirty patients with ages ranging from 8 to 11 years and 6 months diagnosed with ADHD with symptoms of inattention, hyperactivity, and/or impulsivity based on objective and medical measures were included in this study.

The following inclusion and exclusion criteria were determined by the medical history taken from the parents of the patients and the medical examination.

Inclusion criteria:

- Children aged from (8 years to 11 years and 5 months) and complaining of symptoms of inattention, hyperactivity, and/or impulsivity.
- Children with average or below average mentality.

Exclusion criteria:

- Children with language or speech disorders.
- Children suffering from hearing impairment, mental retardation, or neuropsychiatric problems.

All children were subjected to the following protocol of assessment:

- I. Patient interview with careful history taking and ENT examination.
- II. Clinical diagnostic aids:

- a. Mental status examination by psychometric test (Stanford Binet intelligence scale 5th edition) to provide mental age [6].

- b. Rapid automatized naming (RAN) test: This is a part of the Modified Arabic Dyslexic screening test (MADST) which is standardized for the age of 6 years, 6 months, and 11 years, 5 months and validated in 2016 [7]. The Modified Arabic Dyslexic screening test (MADST) is the modification of "Arabic Dyslexia Assessment Test" which was submitted from the original dyslexia screening test (DST) [8]. Both of Arabic Dyslexia Assessment Test and Modified Arabic Dyslexic screening test comprise 11 sub-tests in five areas (literacy skills, phonological awareness and verbal memory, motor skill and balance, and memory retrieval fluency). The Modified Arabic Dyslexic screening test (MADST) does not provide a formal diagnosis of dyslexia, but "at risk" index, providing an indication of dyslexic traits. The raw score of RAN test obtained by the child, regarding the time taken and number of pictures correctly said by the child, will be converted to percentile range in which "below the 25th percentile" is considered as (at risk) and is considered (average performance) when the raw score is at the 25th percentile (see [Appendix](#)).

### Data management and analysis

Descriptive and inferential statistical procedures were considered. The data are collected, tabulated, and statistically analyzed with the program Statistical Package for Social Science (SPSS) under Windows version 20.

### Descriptive statistics

1. Mean and standard deviation ( $\pm$  SD) for numerical data.
2. Frequency and percentage of non-numerical data.

## Results

### Demographic data for cases

- The patients' age ranged from 8 to 11 years and 6 months with a mean of  $9.3 \pm 1.2$  years as shown in Table 1.
- With regard to the gender, there were 26 males (86.7%) and 4 females (13.3%) as shown in Table 2.

### ADHD subtypes and severity

**Table 1** Mean age among studied group

	Minimum	Maximum	Mean	S.D
Age in years	8	11 and 6 months	9.3	1.2

**Table 2** Demographic data for cases

		Frequency	Percent
Gender	Females	4	13.3%
	Males	26	86.7%

**Table 3** ADHD subtypes for cases

ADHD		Frequency	Percent
Cases (30)	Hyperactive	4	13.3%
	Inattentive	12	40%
	Mixed	14	46.7%

**Table 4** ADHD severity for cases

ADHD		Frequency	Percent
Cases (30)	Mild	16	53.3%
	Moderate	4	13.3%
	Sever	10	33.3%

**Table 5** IQ assessment for cases

		Frequency	Percent
IQ	Below average (below 90)	6	20%
	Average ( $\geq 90$ )	24	80%

**Table 6** RAN duration

		Frequency	Percent
RAN duration	Below 25th percentile	24	80%
	At 25th percentile	6	20%

- With regard to ADHD subtypes, there were 4 hyperactive cases (13.3%), 12 inattentive cases (40%), and 14 mixed cases (46.7%) as shown in Table 3.
- With regard to the ADHD severity, there were 16 mild cases (53.3%), 4 moderate cases (13.3%), and 10 severe cases (33.3%) as shown in Table 4.

#### IQ assessment of the cases

- With regard to the IQ assessment, there were 6 cases with below average mentality (20%) and 24 cases with average mentality (80%) as shown in Table 5.

#### Rapid Automatized Naming test scoring among cases

- With regards to the duration of the RAN test, there were 24 cases out of the 30 cases (80%) below the 25th percentile (at risk) and 6 cases out of the 30 cases (20%) at the 25th percentile (average performance) as shown in Table 6.
- With regard to the accuracy of RAN, there were 10 cases (33.3%) below the 25th percentile (at risk) and 20 cases (66.7%) at the 25th percentile (average performance), as shown in Table 7.

#### RAN in different ADHD subtypes

- No significant difference was found in the duration and accuracy of the RAN test between different types of ADHD as shown in Table 8.

### Discussion

Rapid Automatized Naming (RAN) is a measure of working memory that predicts the ability of perceiving and rapid accurate retrieval of the visual symbol (e.g., an object) through uttering of its name [9].

Some behavior characteristics such as difficulties with attention (short memory and attention span), impulsivity, or increased motor activity seem to be normal behaviors in little children with different developmental paths [10].

**Table 7** RAN accuracy

		Frequency	Percent
RAN accuracy	Below 25th percentile	10	33.3%
	Above 25th percentile	20	66.7%

**Table 8** Duration and accuracy of RAN in different ADHD subtypes

		ADHD type						Fisher's exact test	
		Hyperactive		Inattentive		Mixed		p value	sig.
		N	%	N	%	N	%		
Duration percentile	At 25th percentile	0	0.0%	2	16.7%	4	28.6%	0.568	NS
	Below 25th percentile	4	100.0%	10	83.3%	10	71.4%		
Accuracy percentile	At 25th percentile	2	50.0%	8	66.7%	10	71.4%	0.763	NS
	Below 25th percentile	2	50.0%	4	33.3%	4	28.6%		

"At risk" for those below the 25th percentile

"Average performance" for those at the 25th percentile

Most of RAN assessment studies in children with ADHD were broadly done in cases of dyslexia with ADHD. However, there are a small number of studies that assess RAN in cases of ADHD without other cognitive disorders.

Most of the previous researches were done for RAN duration, and there are no sufficient researches for accuracy. This study aimed to illuminate the relations between ADHD symptoms and RAN over the course of early childhood, to assess potential weaknesses in naming speed abilities of children with ADHD and to compare naming speed abilities among ADHD subtypes.

Demonstration of cognition affection in Egyptian ADHD children is considered as one of the present study's results as it demonstrates the reaction-time task which is obvious on self-paced rapid naming tasks.

Rapid color naming and rapid letter naming which may be directly applicable to reading are used to be identified in many previous investigations [9, 11], with

color naming showing more affection than deficits in letter naming [12].

Although most official tests for rapid naming use the original set of colors, letters, and digits, in the current study, serial pictures of 40 familiar objects of monosyllabic words were chosen to test for RAN, to be named from right to left. It was found that letters and digits are not preferably used because some tested children may not have been exposed to alphabets, colors, or the numbers in their education level. In such cases, their performance in these items will affect the total rapid naming score negatively. That is why object naming in the pure sense may be more indicative of the task. In addition, object naming is acquired earlier than colors, letters, and digits.

Most of the previous researches assessed Rapid Automatized Naming in terms of speed of naming. Ryan et al. (2016) assessed 80 children aged from 9 to 14 years (which subdivided into 2 groups: cases of ADHD "45"

## Appendix



**Fig. 1** Rapid Automatized Naming: Item of MADST test [7]

children and control “35” children). Letter rapid naming was the measure of retrieval automaticity. There was a markedly slower performance in children with ADHD compared to the control group.

In Alves et al.’s (2016) study, there were 70 children aged between 8 and 11 years. They were subdivided into 16 children that were diagnosed with ADHD while 14 were diagnosed with dyslexia; matched with these groups, 40 schoolchildren with no developmental impairments also evaluated as the control group. The RAN test was used to assess the time required for naming a series of familiar visual stimuli. The ADHD group had a lower performance for color and letter naming tasks while the dyslexic children showed a lower performance than that of the control group in all tasks. With age, there are fast answers on color and digit tasks in the control group children with typical language development while there is no improvement with age in children with dyslexia or ADHD.

In the current study, the results obtained showed that 80% of the tested patients had slow response in times (i.e., inter-item pauses) apparent in the performance of children with ADHD which supports studies previously conducted [11, 13, 14]. According to these studies, the naming of any visual stimulus requires access to their phonological and semantical information (meaning) for accurate pronunciation of their name. As pictures, objects, and colors have a greater semantics information, so their pronunciation requires more time which could explain the above results [11, 15].

The increased risk in children with ADHD for failure on both core reading-related tasks and on more complex tasks is due to the presence of these performance lapses in those children. It becomes clear from an increasing number of studies examining response control in ADHD children [16, 17] that tasks require longer controlled and sustained performance within the classroom.

Naming objects and color tasks have higher semantics load which need greater stress on working memory to be able to retrieve their name accurately [14].

By comparing the finding of the RAN test in different ADHD subtypes of the present study, 100% of hyperactive cases show a delay in response time while only 50% of hyperactive cases lie below the 25th percentile of the accuracy percentile, while in inattentive and mixed types, there was affection in duration more than accuracy.

By applying Fisher’s exact test, no significant difference in the RAN task performance in duration and speed between different ADHD subtypes was found.

## Conclusions

The present study showed that RAN which represent working memory are affected in duration more than

accuracy among children with attention deficit hyperactivity disorder (ADHD) relative to children without ADHD.

## Abbreviations

ADHD: Attention-deficit/hyperactivity disorder; ADHD-C: Attention-deficit/hyperactivity disorder predominantly combined type; ADHD-H: Attention-deficit/hyperactivity disorder predominantly hyperactive-impulsive type; ADHD-I: Attention-deficit/hyperactivity disorder predominantly inattentive type; DST: Dyslexia screening test; ENT: Otorhinolaryngology; IQ: Intelligence quotient; MADST: Modified Arabic Dyslexic screening test; RAN: Rapid automatizing naming; SPSS: Statistical Package for Social Science

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## Authors’ contributions

S.B. made the design of the work. H.G. contributed to the analysis and interpretation of the study. D.A.G. collected and tabulated the data. Y.H.E. wrote the manuscript and shared in analyzing the results. All authors read, revised, and approved the final manuscript. We declare that this manuscript is original, has not been published before, and is not currently being considered for publication elsewhere. We know of no conflicts of interest associated with this publication, and there has been no significant financial support for this work that could have influenced its outcome. The corresponding author confirms that the manuscript has been read and approved for submission by all the named authors. The requirements for authorship as stated have been met, and that each author believes that the manuscript represents honest work.

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## Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Declarations

### Ethics approval and consent to participate

The present study was approved by the Research Ethics Committee for Experimental and Clinical Studies of the Faculty of Medicine, Ain Shams University (FMASU REC). The FMASU REC is organized and operated according to the guidelines of the International Council on Harmonization (ICH) Anesthesiology and the Islamic Organization for Medical Sciences (IOMS), the United States Office for Human Research Protections, and the United States Code of Federal Regulations and operates under Federal Wide Assurance No. FWA 000017585.

This study was approved by Ain Shams institute’s ethical committee in May 2019, reference number 135/2019.

An oral consent has been obtained from the parents of all children included in the study. Patient privacy and confidentiality were protected. Deceptive practices were avoided during designing the research. The participants had the right to withdraw from the study at any time they wished.

### Consent for publication

Not applicable.

### Competing interests

The authors declare that they have no competing interests.

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