Developmental Normative Data of the Rey-Osterrieth Complex Figure Test in an Egyptian Population

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Abstract

This study aimed to provide Egyptian normative data of the Rey Osterrieth Complex Figure Test (ROCFT). The ROCFT as a well-known neuropsychological non-verbal test still has limited use in the clinical practice because of the shortage of normative data. A total of five hundred and twenty one healthy subjects between the ages of 9 and 24 years (272 females, mean age = 17.268 (3.93) and 249 males mean age= 17.155 (3.93) participated. All subjects were native Arabic speakers who have been recruited from grade four to grade 12 (n= 286) and from Benha university students (n= 235). The stratified sample consists of five age groups, (9–12, 12.01–15, 15.01–18, 18.01–21 and 21.01+ years) without equal numbers of males and females in each age group. Participants were administered the tests as part of a larger study aimed to establish local normative data of some neuropsychological test. They were not told that the test would involve remembering the ROCF. The results indicated thatage and education years influence slightly copy accuracy scores and age only influence the immediate recall scores, the education years and age could not predict independently of ROCF copy scores, the results showed prediction models, where age and education years explained the variance of copy scores. Age appeared to predict only performance on the immediate recall task. This study provides Egyptian age-related norms to ROCF. Also the study supports the neuropsychologists with a valuable tool in clinical practice based on healthy and educated Egyptians subjects.

Keywords: Rey Osterrieth Complex Figure, ROCFT, Neuropsychology, Nonclinical Sample, Normative Data.

Introduction

The Rey-Osterrieth Complex Figure Test (ROCFT) has a long history in the field of neuropsychological assessment (Strauss, Sherman and Spreen, 2006, 811). First of all, this test was developed by Rey (1941) as a test for visuospatial, constructional ability and visual memory to brain-damaged patients. Aftera few years, Osterrieth (1944) invented a scoring system and published the first normative and standardized Rey's administration procedure (Corwin and Bylsma, 1993; Shin et. al., 2006). ROCFT took place as the most commonly used instruments in both clinical and experimental settings (Lezak,et.al.2012; Frank andLandeira-Fernandez, 2008).

Historically, Rey (1941) created ROCFT to evaluate the impact of traumatic encephalopathy on nonverbal memory and visuospatial abilities. Since his pioneered work, the benefits of ROCFT in the cognitive and clinical neuropsychological assessment were growing increasingly. The neuropsychologist can use successfully the ROCFT in assessment of visual organization (Olsen, 1997; Anderson, Anderson and Garth, 2001), visuospatial memory (Ha, et al., 2012; Scala et al., 2013; Lezak, Howieson, and Loring, 2004), visuospatial skills (Bloch et al. 2011; Lipowska, Czaplewska and Wysocka 2011), figural memory (Hoffnung, 2002), executive Functioning (Beebe et al. 2004; Watanabea et al 2005; Ogino et al. 2009; Elderkin-Thompson et al., 2004; Torpey, 2004), visuomotor integration (Rinehart and Bradshaw, 2014), and organizational skills (Teknos, Bernstein, and Seidman, 2003; Seidman et al., 1995). Due to its sensitivity to nonverbal cognitive functions, the ROCFTtook a remarkable status in clinical settings, as a standalone test and as a part of neuropsychological batteries.

Woodrome and Fastenau (2005) considered ROCFT as a basic component of neuropsychological batteries. It is used by approximately two-third of neuropsychologists (Knight, Kapland and Ireland, 2003), to evaluate both children and adult central nervous system (CNS) functional and organic problems, including ADHD (Olsen, 1997) Temporal lobe and rolandic epilepsy (Kwon, Seo, and Hwang, 2012, McConley, Martin, Banos, Blanton, &Faught, 2006), sleep problems (Gregory et. al., 2009) acute Lymphoblastic Leukemia (Lesnik et al 1998)dyslexic children (Lipowska, Czaplewska and Wysocka 2011), for children, amnestic disorders in adults (Scala et al., 2013, Ha, et al., 2012; Kixmiller et al 2000), Alzheimer's disease (Kwak, ,2004; Lu et al., 2003), Right-Brain Stroke (Chen et al., 2012) Obsessive-Compulsive Disorder (Bloch, et. al., 2011), Sports-Related Concussion (Keightley, et al., 2014) Neuropsychological Measure in Criminal Offenders (Cornell, Roberts, and Oram, 1997), alcoholism (Dawson and Grant, 2000), drug abuse (Selby and Azrin, 1998), solvent exposure (Milanovic et al 1990), and asymptomatic HIV seropositive status (McManis, et al 1993).

Because of the importance of ROCF test in neuropsychological evaluation, each community interested in producing culturally sensitive normative data for performance on both copy and recall trial. In this regard, the majority of normative data were implemented on elderly populations with various ethnics and languages, samples Italians (Caffarra et al., 2002), English (Meyers & Meyers, 1995; Fastenau et al., 1999; Machulda et al., 2007) Spanish-speaking Americans (Pontón et al., 1996), and Spanish individuals (Pen˜a-Casanova et al., 2009) as well as Arabic (Darwish, et al., 2018). Now, ROCFT is one of the most cross-culturally adapted instruments throughout the world with national

age-adjusted normative data except Egypt, it should be noted that the ROCFT has been used in a few Egyptian and Arabian studies such as (Mohammadi and El-Zaqai, 2010; Safari and Haddadi, 2015; Rumana, 2018; and Mahmoud, 2017). These studies did not provide evidences of validity and reliability. Despite, the importance of the ROCFT in psychological training programs, till now there are no developmental, educational and/or age-adjusted norms in Egyptian samples.

The standardisation of neuropsychological tests in the Arab region remains absent (Darwish, Zeinoun, Farran, and Fares, 2018).These tests may be sensitive to the varying cultural experiences. So, Egyptian individuals need for normative data, according to culture assumption, they differ from other North-Americans subpopulations, French-Canadians and French-speaking people worldwide on several aspects (e.g., native language, sex, age and education system). The present work aimed to establish normative data in considering the impact of age and sex variables on ROCF task performance.

Review of literature

Description and scoring systems of ROCF test:

The ROCF test has a very remarkable history of development since Andre Rey's first research (1941), which he used ROCFT as a neuropsychological examination of cases of traumatic encephalopathy.The classical way of ROCFT consisted of administration of typical stimulus as in Fig. 1, which has 47 lines or elements in a copy and 3 minutes delayed as a recall trial, and scoring system that adopted an assessment of time required to draw a copy by colored pencils that changed by regular intervals, which

served as tracking the strategy to complete the copy of the stimulus. Rey used the copying data as a measure of the visual perception ability, and applied the counting of total elements accuracy recalled of reproduction of the figure as immediate visual memory efficiency. Rey postulated his observations and guidelines to analyze the data (as cited in Corwin & Bylsma, 1993). After 3 years, Paul Osterrieth published the first normative data for children and adult. The contributions of Osterrieth were recognizing seven strategies utilized in the copy phase and identifying 18 elements used in quantifying the score of each trial (see appendix 1.

The description of ROCFT standard form is complex, two-dimensional, geometric, constructional, abstract, and nonverbal test (Frank and Landeira-Fernandez, 2008; Chin et. al. 2006; Caffarra et. al., 2002; Scott 1999; Chen et. al., 1999). It is a paper – pencil test (Klaas, 1999), consists of large rectangle with internal and external geometric designs like triangles, lines, circle, crosses and diamond attached to the tip of the figure as shown in (fig. 1). The unique features of the test's visual quality give an explanation of the diversity of cognitive abilities (Rivera, Perrin, Morlett-Paredes, Galarza-del-Angel, Martinez, Garza, et al. 2015). To achieve this purpose, the administration procedures and scoring systems varies according to the targeted functions. Where, it is assumed the copy trial of the ROCF evaluates the perceptual and executive functions (Watanabe, Ogino, Nakano, Hattori, Kado, Sanada, and Ohtsuka., 2005) . On the other hand, reproduction trials immediately (immediate, or 3-minutes recall) and after delayed interval (approximately 30 minutes) designed to assess the spatial working memory (Corwin &

Bylsma, 1993, Meyers & Meyers, 1995, Strass, Sherman and Spreen, 2006, 813-820, Gallagher and Burke, 2007, Scala et al., 2013).

The ROCFT test has undergone to several developments with respect the equivalent forms and scoring system (for further details, review Strass, Sherman and Spreen, 2006, 881-841). The scoring system of copy and recall trial that Rey and Osterrieth developed, reflect directly the attention and perception of impeded figures and visual memory function with maximum score 36 points. However, the administration procedures has varied since the original work, but the scoring systems always bases on 36 point schema (Bennet-Levy, 1984; Loring, Martin, eador& Lee, 1990; Rapport, Charter, Dutra, Farchione, & Kingsley, 1997). The various administration procedures of ROCF test varied only in the interval time between the copying trial and immediate recall trial and then delayed recall. According to the review of Crown and Bylsma (1993) and Mayer and Mayer (1995) that described the most frequent administration technique, which established 30 sec. for interval between copy trial and immediate recall trial, and interval time range from 15-60 minutes for delayed recall trial had little effect on accuracy of recall (as cited by Corwin & Bylsma, 1993; Meyer & Meyer,1995).

The normative data of ROCFT performance:

The neuropsychological tests influenced by Sociodemographic variables, especially the impact of age, education, and sex, so we noticed that the literature of ROCFT took into account the effect of age and sex on copy and recall trials. Most studies have targeted to establish norms for the performance of older persons, adults and few of studies aimed for developing developmental age standards for children and adolescents.

Several studies examined the impact of age on ROCFT performance,

Waber and Holmes (1985) reported developmental changes in children copying trial of ROCFT. They developed a normative data for a sample of 454 children between 5 and 14 years. According to their method of copy scoring criteria.they found significant differences due to themain effect of age variable but not for the sex.In an unselected normal and healthy adolescent's sample. Poulton and Moffitt (1994) conducted a normative data study;the ROCFT was administered to 740 children aged 13 years. They found nosignificance sex based differences in accuracy of copy but the sexonly affected the recall score. Also, Palomo et al., (2013) presented as a part of Spanish normative studies in young adults (NEURONORMA young adults project), an age- and education-adjusted normative data for ROCFT. Theyobtained norms by using linear regression techniques. The sample consisted of 179 healthy participants ranging in age from 18 to 49 years. The results showed a significant age effect on immediate recall for the ROCFT andthere was nosignificant sexeffect on any of the ROCFT variables.

Arango-Lasprilla et. Al.,(2017) replicated Palomo et al., (2013). They conducted cross countries generated normative data for the ROCFT in Spanish-speaking pediatric populations. Indeed, theyrecruited large healthy children (N= 4,373) from nine Latin America and Spain countries. Normative values tables of stratified samplesusing multiple linear regressions suggested the assumption of culture effects on ROCF copy and immediate recall (3 minutes). They assessed the impact of sociodemographic variables (age, sex, parental education) as predictors in the analyses. Theresults showed prediction

models, where age explained the variance of copy and immediate recall scores, such that scores increased linearly as a function of age.

Caffarra, Vezzadini, Dieci, Zonato, and Venneri (2002) aimed to producean Italian normative databased onhealthy subjects sample (n=280) aged from 20 to 89 years old, the total mean age 53.98(19.80).for both direct copying and delayed recallof the ROCF,the results revealed significant effects of age and education on performance of both copying tasks, whereas sex appeared to affect only performance on the delayed recall task.On different age range, Fernando, K.; Chard, L.; Butcher, M.; Christeen M, (2003) investigated the culture sensitivity of ROCFT compared with American and English norms. Fernando and his colleagues applied the ROCFT on 840 children aged 7-18 years. Their results showed that there was an improvement in performance related to age increasing and there were no significant differences due to age or race. They confirmed the culture sensitivity of ROCFT as a result of comparing the New Zealand norms with American norms.

It is important to note that the importance of an ROCF test drew attention at the African culture. The Shuttleworth-Edwards, De Kock, and Radloff (2014) study, provided preliminary norms for Xhosa speaking unskilled workers, with age ranges from 18 to 40, however the small sample size (N = 33) (females n = 21; males n = 12), their results indicated that there was an age effect in favour of the younger group. On the Asian side of Arab world, A Lebanese team interested in providing normative data the ROCF Test, the Darwish, Zeinoun, Farran, and Fares, (2018) administered the ROCFT on a sample of Lebanese (n = 254) aged 30 years to 99. The impact of age, gender and

education variables was significantly clear, because of the wide range of ages encompassed at least two stages encompass adulthood and aging stages. The norms they gave, is considered as the first adult normative data in Lebanese culture.

After reviewing the previous studies, the basic assumption of current study (a) the effect of age on ROCFT copy trial performance may be due to the neurocognitive development and reflects the development of executive functions, (b) the sample recruitment from different educational levels so, the variable of education years will be examined, (c) the age-related increase will beaccounted by age-related development of executive function (accuracy of copy and recall trial), (d) based on the controversial effect of sex on the ROCFT scores, the current study assume an interaction impact between age and sex.There is an agreement among researchers that nonverbal tests are not free from cultural bias. Therefore, the development of local standards covering multiple cultures within societies has become a necessity to increase the efficiency of neuropsychological tests in clinical practice to distinguish cognitive disorders (Arsenault-Lapierre, et. al., 2011; Tremblay et al., 2014).

MATERIALS AND METHODS

Participants:.A total of five hundred and twenty one healthy subjects between the ages of 9 and 24 years (272 females, mean age = 17.268 (3.93) and 249 males mean age= 17.155 (3.93) participated. All subjects were native Arabic speakers who has been recruited from grade four to grade 12 (n= 286) and from Benha university students (n= 235). Participants were stratified across five age groups (9–12, 12.01–15, 15.01–18, 18.01–21 and 21.01+ years) without equal numbers of males and females in each age group. All participants

were right handed. The data included in this study were collected bytrained psychologystudents at psychology department, Benha University. The table (1) shows the demographic characteristics of the sample.

Table (1)
Participant Demographics (N=521)

Measure	n	%
Sex		
Male	249	48
Female	272	52
Age groups		
9.01 - 12.00	60	11.5
12.01 - 15.00	143	27.4
15.01 - 18.00	82	15.7
18.01 - 21.00	141	27.1
21.01+	95	18.2
Education year		
<= 4.00	21	4.0
5.00 - 7.00	73	14.0
8.00 - 10.00	148	28.4
11.00 - 13.00	127	24.4
14.00+	152	29.2

Materials: A copy of the Rey–Osterrieth Complex Figure Test (ROCFT) (Osterrieth, 1944; Rey, 1941) was used. A pencil, pencil sharpener and blank sheets of paper were provided for the participants to draw the figure. Standard progressive matrices (SPM) were used to estimate criterion validity.

Procedure: Relevant to the purpose of the current study, participants were administered the tests as part of a larger study aimed to establish local normative data of some neuropsychological test. Initially, participants were given 5 minutes to copy the ROCF, after which timeboth the original figure and their copy were removed from view. They were not told that the test would involve remembering the ROCF. Thirty seconds later, they were asked to draw the figure from memory as best they could. No time limit was imposed on this trial. After testing was completed, the

ROCF drawings were scored for accuracyusing Taylor's (1969) scoring criteria (see Spreen& Straus, 2006).

The result:

The test internal consistency (Cronbach's Alpha) was (0.781). The criterion (group A of SPM) validity was (r= 0,693).

Table (2)

Correlation coefficients (*r)* between the copy and immediate recall trial of ROCF test based on age classification and sex

age range	sex	r	R2
9. -12	male	0,650**	0,42
	female	0,511**	0,26
12,01-15	male	0,400**	0,16
	female	0,702**	0,49
15,01-18	male	0,685**	0,47
	female	0,267	0,07
18,01-21	male	0,232	0,05
	female	0,416**	0,17
21,01+	male	0,357*	0,13
	female	0,523**	0,27

Note., p*< .05 , ** *p*< .01

Table (2) contained that correlation coefficients (r) between the copy score of each age classifications and recall scores variables. Correlation coefficients within age (9 -12), showed a positive correlation between the copy and immediate variables, r_{male}= 0,650, p = < .01, with a R2 = 0,42; r_{female}= 0.511, p = < .01, with a R2 = 0,26. There was Correlation coefficients within age (12.01-15), showed that, r_{male}= 0.400, p = < .01, with a R2 = 0,16; r_{female}= 0.702, p = < .01, with a R2 = 0.49. Also there was positive correlation coefficients within age (15.01-18), showed that, r_{male}= 0,685, p = < .01, with a R2 = 0.47; r_{female}= 0,267, with a R2 = 0,07. There was correlation between copy and recall scores in male

group (age range: 18.01 to 21) r_{male}= 0232, R2=0.05; but r_{female}= 0,416, p = < .01, with a R2 = 0.17. There was correlation between copy and recall scores of group (age range: 21.01 to 24) r_{male}= 0.357, p = < .01, with a R2 = 0,13; but r_{female}= 0,523, p = < .01, with a R2 = 0,27.

Table (3)

Predicting ROCF test scores from Sex and Age and education years variables

Predictor	*dependent*	*intercept*	*b*	$CI_{95\%}$ for *b*		β	*r*	sr^2
				Lower	Upper			
age[a]	Total Copy scores	27,469	0,255	0,165	0,344	0,238	0,238	0,06
age[b]	Copy placed properly	21,638	-0,473	-1,434	0,488	- 0,263	0,390	0,15
Education years			1,273	0,242	2,304	0,660	0,400	0,16
age[c]	Total Immediate recall scores[b]	20,364	0,213	0,077	0,349	0,134**	0,176	0,03

Note. a. Fit for model R^2 = 0,057, F(1, 519) = 31,242, p < 0,000
b. Fit for model R^2 = 0,162, F(2, 518) 49,914, p < 0,000
c. Fit for model R^2 = 0,018, F(1, 519) = 9,424, p < 0,002

Table (3) showed that stepwise linear regression analyses carried out to investigate whether sex, age, and education years could significantly predict participants' ROCF- copy scores. The results indicated that the model (age) explained 5.7% of the variance and the model was a significant predictor of copy performance, F (1,519) = 31.242, p = .000, (B = 0.238, p<.000). While a model of age and education years contributed significantly in explaining 16.2 % the variance of the of ROCF copying elements accurately and the model significantly, F(2, 518) = 49.914, p = .000, (B = 0.660, p= .016). With regard to the ROCF- immediate recall, only age was significantly explained 1.8% of immediate recall scores variance. The model significantly predictor of recall performance, F (1, 519) = 9.424, p = .002; (B = 0.134, p=.002).

Table (4)

Results of t-test and Descriptive Statisticsof 9 to 12 years for ROCFT by Sex

	Sex							
	Male (n=31)		Female (n=29)		95% CI			
	M	SD	M	SD	for Mean Difference		t	Sig. (2-tailed)
age	10,80	0,95	10,64	0,93	-0,33	0,64	0,65	0,52
copy placed properly	24,24	9,28	23,86	7,99	-4,11	4,87	0,17	0,87
copy placed poorly	2,61	2,58	3,14	1,85	-1,69	0,64	-0,90	0,37
distorted copy placed properly	2,58	2,36	2,59	2. ,	-1,17	1,16	-0,01	0,99
distorted copy placed poorly	1,61	3,39	1,88	3,31	-2,00	1,47	-0,31	0,76
copy omission	4,95	6,53	4,53	5,85	-2,80	3,63	0,26	0,80
ROCF-copy	31,05	6,53	31,47	5,85	-3,63	2,80	-0,26	0,80
recall placed properly	14,11	8,26	14,59	7,14	-4,48	3,53	-0,24	0,81
recall placed poorly	2,39	2,69	2,48	1,86	-1,30	1,11	-0,16	0,87
distorted recall placed properly	2,35	2,26	2,52	1,62	-1,18	0,86	-0,32	0,75
distorted recall placed poorly	2,37	2,83	2,64	2,57	-1,67	1,13	-0,38	0,70
recall omission	14,77	8,50	13,78	7,63	-3,19	5,18	0,48	0,63
ROCF-recall	21,23	8,50	22,22	7,63	-5,18	3,19	-0,48	0,63

At age range (9 -12), table 4 showed There was no significant difference between males and females in ROCFT copy and recall scores, this kind of similarity in performance on spatial visual skills, regulation and short-term memory may be due to pre-puberty factors. We noticed at age range 12.01-15 in the table (5) showed that the sex variable had no impact on the copy of ROCFT. With regard to the distortions errors, the male scores significantly worse than female and there was a significant difference between males and females in (distorted copy elements that were placed poorly), the male's (M=0.28, SD=0.60) compared with female (M=0.10, SD=0.29), t (141) = 2.36, p = 0.02. The primary impact of sex variable on ROCF recall got significant differences in

favor of females as expressed by the average of male (M=22.42, SD=6.59) compared with female average (M=24.80, SD=6.32), t (141) = -2.20, p = 0.03. Also, there were significant differences in the omission or forgotten elements, while male score (M = 13.58, SD =6.59) compared with female scores (M=11.20, SD=6.32), t (141) = -1.70, p = 0.03.

Table (5)

Results of t-test and Descriptive Statisticsof 12.01 to 15 years for ROCFT by Sex

	Sex							
	Male (n=65)		Female (n=78)		95% CI for Mean Difference		t	Sig. (2-tailed)
	M	SD	M	SD				
age	14.13	0.82	14.18	0.83	-0.32	0.22	-0.37	0.71
copy placed properly	24.08	7.75	25.47	7.08	-3.84	1.07	-1.11	0.27
copy placed poorly	4.77	3.02	4.47	3.06	-0.72	1.30	0.58	0.56
distorted copy placed properly	1.06	1.83	0.69	1.04	-0.11	0.85	1.52	0.13
distorted copy placed poorly	0.28	0.60	0.10	0.29	0.03	0.33	2.36*	**0.02**
copy omission	5.80	5.13	5.26	4.32	-1.03	2.10	0.68	0.50
ROCF-copy	30.20	5.13	30.74	4.32	-2.10	1.03	-0.68	0.50
recall placed properly	15.42	7.91	17.72	8.17	-4.97	0.37	-1.70	0.09
recall placed poorly	4.49	3.26	4.32	3.12	-0.89	1.23	0.32	0.75
distorted recall placed properly	1.52	1.80	2.05	2.44	-1.25	0.19	-1.44	0.15
distorted recall placed poorly	0.98	1.33	0.71	0.94	-0.11	0.65	1.42	0.16
recall omission	13.58	6.59	11.20	6.32	0.25	4.53	2.20*	**0.03**
ROCF-recall	22.42	6.59	24.80	6.32	-4.53	-0.25	-2.20*	**0.03**

*$p < 0.05$

Table (6)

Results of t-test and Descriptive Statisticsof 15.01 to 8 years for ROCFT by Sex

	Sex							
	Male (n=37)		Female (n=45)		95% CI for Mean Difference		t	Sig. (2-tailed)
	M	SD	M	SD				
age	16.51	0.82	16.81	0.84	-0.66	0.07	-1.59	0.12
copy placed properly	24.65	7.25	25.40	6.05	-3.67	2.17	-0.51	0.61

copy placed poorly	4.00	2.86	4.40	2.89	-1.67	0.87	-0.63	0.53
distorted copy placed properly	1.19	1.45	0.82	1.25	-0.23	0.96	1.23	0.22
distorted copy placed poorly	0.08	0.22	0.09	0.25	-0.11	0.10	-0.15	0.88
copy omission	6.08	4.14	5.22	3.51	-0.82	2.54	1.02	0.31
ROCF-copy	29.92	4.14	30.71	3.43	-2.45	0.87	-0.95	0.35
recall placed properly	17.57	8.52	16.32	7.58	-2.29	4.78	0.70	0.49
recall placed poorly	4.89	2.84	4.29	3.01	-0.69	1.90	0.93	0.36
distorted recall placed properly	1.73	1.63	1.69	2.07	-0.79	0.87	0.10	0.92
distorted recall placed poorly	0.32	0.56	0.68	1.03	-0.73	0.02	-1.88	0.06
recall omission	11.49	6.25	13.02	6.49	-4.36	1.28	-1.08	0.28
ROCF-recall	24.51	6.25	22.98	6.49	-1.28	4.36	1.08	0.28

Table 6, we notice that within the age range from 15.01-18), there were no significant sex differences between males and females in copy and recall trial; except the amount of distorted element that retrieved and placed poorly, where male average (M=0.32, SD=0.56) compared with female (M=0.68, SD=1.03); t (85) = -1.88, p = 0.06. In

Table (7)

Results of t-test and Descriptive Statisticsof 18.01 to 21 years for ROCFT by Sex

	Sex							
	Male (n=70)		Female (n=71)		95% CI for Mean Difference		t	Sig. (2-tailed)
	M	SD	M	SD				
age	19.49	0.82	19.77	0.94	-0.58	0.01	-1.92	0.06
copy placed properly	31.11	4.53	31.48	4.25	-1.83	1.10	-0.49	0.62
copy placed poorly	1.10	1.18	1.23	1.53	-0.58	0.33	-0.54	0.59
distorted copy placed properly	1.16	1.53	0.82	1.06	-0.10	0.78	1.54	0.13
distorted copy placed poorly	0.02	0.13	0.02	0.13	-0.04	0.04	0.01	0.99
copy omission	2.61	2.45	2.46	2.31	-0.64	0.94	0.37	0.71
ROCF-copy	33.39	2.45	33.54	2.31	-0.94	0.64	-0.37	0.71
recall placed properly	19.94	5.89	21.72	6.24	-3.80	0.24	-1.74	0.08
recall placed poorly	1.37	1.58	1.41	1.73	-0.59	0.51	-0.13	0.89
distorted recall placed properly	3.03	2.01	2.73	1.60	-0.31	0.90	0.97	0.34
distorted recall placed poorly	0.36	0.52	0.32	0.52	-0.13	0.21	0.46	0.65
recall omission	11.29	4.59	9.82	4.72	-0.07	3.03	1.88	0.06
ROCF-recall	24.71	4.59	26.18	4.72	-3.03	0.07	-1.88	0.06

Table 7, the results demonstrated that within the age range from (18.01-21), there were no significant sex differences between males and females in copy scores but recall trial scores received direct impact of sex variable on both immediate recall scores and omission of ROCFT elements; where male recall average (M=24.71, SD=4.59) compared with female (M=26.18, SD=4.72); t (139) = -1.88, p = 0.06. besides that, Forgetfulness is worse in males than female; where male omission average (M=11.29, SD=4.59) compared with female (M=9.82, SD=4.72); t (139) = -1.88, p = 0.06.

Table (8)

Results of t-test and Descriptive Statisticsof 21.01 to 24 years for ROCFT by Sex

	Sex							
	Male (n=46)		Female (n=49)		95% CI for Mean Difference		t	Sig. (2-tailed)
	M	SD	M	SD				
age	22.69	1.02	22.90	1.00	-0.62	0.20	-1.03	0.31
copy placed properly	31.85	3.94	29.96	5.97	-0.19	3.96	1.81	0.07
copy placed poorly	0.70	1.01	1.61	1.47	-1.43	-0.40	-3.52**	**0.00**
distorted copy placed properly	1.28	1.61	0.96	1.38	-0.29	0.93	1.05	0.30
distorted copy placed poorly	0.00	0.00	0.05	0.15	-0.10	-0.01	-2.26*	**0.03**
copy omission	2.11	2.13	3.42	3.79	-2.57	-0.04	-2.06*	**0.04**
ROCF-copy	33.83	2.11	32.58	3.79	-0.02	2.51	1.96*	**0.05**
recall placed properly	19.83	7.31	19.06	7.44	-2.24	3.77	0.50	0.61
recall placed poorly	1.17	1.48	1.71	1.22	-1.09	0.01	-1.94*	**0.05**
distorted recall placed properly	2.72	1.59	2.53	1.37	-0.42	0.79	0.61	0.54
distorted recall placed poorly	0.41	0.63	0.72	0.95	-0.64	0.02	-1.88	0.06
recall omission	11.87	6.31	11.97	6.29	-2.67	2.47	-0.08	0.94
ROCF-recall	24.13	6.31	24.03	6.29	-2.47	2.67	0.08	0.94

*$p < 0.05$, **$p < 0.01$

At the range age 21.01 to above the table 8 showed that there were significance sex differences in copy trial score in male (M=33.83, SD= 2.11) compared with female

(M=32.58, SD=3.79); t (93) = 1.96, p = 0.05, as well as, elements of ROCFT copy that was placed poorly were significantly impacted by sex, in male (M=0.70, SD= 1.01) compared with female (M=1.61, SD= 1.47); t (93) = - 3.52, p = 0.000. Obviously, the results revealed signs of visual attention variations between males and females at this range of age, there were significance differences in omission of ROCFT elements, where male (M=2.11, SD= 2.13) compared with female (M=3.42, SD= 3.79); t (93)= -2.06, p = 0.04. the impact of sex vanished for recall scores without any significant differences.

Table (9)

Percentiles , mean and standard deviations of ROCFT by age groups

Age groups		9.01 - 12.00 N=60		12.01 - 15.00 N=143		15.01 - 18.00 N=82		18.01 - 21.00 N=141		21.01+ N=95	
		ROCF-copy	ROCF-recall	ROCF-copy	ROCF-recall	ROCF-copy	ROCF-recall	ROCF-copy	ROCF-recall	ROCF-copy	ROCF-recall
Mean		31.25	21.71	30.49	23.72	30.35	23.67	33.47	25.45	33.18	24.08
Std. Deviation		6.16	8.04	4.70	6.53	3.76	6.39	2.37	4.70	3.14	6.27
Percentiles	1	13	2	18	7	20	6	26	13	17	4
	10	21	7	24	15	26	16	30	19	29	16
	20	26	16	27	18	27	18	32	22	31	20
	30	30	18	28	21	28	20	33	24	32	22
	40	34	21	29	22	29	23	34	25	33	24
	50	34	23	30	25	31	24	34	26	34	26
	60	34	25	32	26	32	26	34	27	35	27
	70	36	27	34	28	33	28	35	28	35	28
	80	36	29	36	30	33	29	36	30	36	29
	90	36	32	36	32	36	32	36	32	36	30
	95	36	32	36	34	36	34	36	32	36	33

Discussion

This study tried to establish local norms of ROCF test score according to different sex and age groups. The results confirms that age and sexhad limited influence on copy

accuracy scores and education variablemay be influence the copy accuracy, the sex, age and education could not predict independently of ROCF copy scores, the results showed prediction models, where age and education years explained the variance of copy (Caffarra, et. al., 2002; Arango-Lasprilla et. al., 2017, Darwish, et. al., 2018). Whereas age appeared to predict only performance on the immediate recall task (Palemo et al., 2013; Caffarra, et. al., 2002). The coefficient of determination reveals that the copying scores vary in explaining total variance of the memory scores across developmental age groups and sex.

The results confirmed the sex and age-related slightly resulted in copy scores differences, but there are inconsistent variations across age groups due to maturity or other developmental factors, the male\female advantages did not occurred at any ages,except (21.01-24) although males typically outperform females on spatial tasks (Sneider et. Al 2014; Toivainen et. Al., 2018),earlier studies did not also consistently agree on sex differences, but the previous studies confirm that the differences are minor or nonexistent (Waber and Holmes, 1985; Linn and Petersen, 1985; Nyborg, 1983, Poulton and Moffitt, 1994;Pen˜a-Casanova, et al., 2009;Palomo et al., 2013), and the inconsistent Sex-related differences in spatial ability may be due to sex-typed experiences (Newcombe, Bandura, and Taylor, 1983). Our results suggested that sex related differences are task- dependents.

A copy trial of the ROCFT is typically used to investigate of spatial perception, attention and executive functions (Watanabe, et al., 2005; Hubley and Tremblay, 2002; Walker, 2014). The performance of ROCFT copy scores were affected by factors like

visual attention, organization, and motor coordination (Biesbroek, et al., 2014; Tremblay et. Al., 2015). The ROCFTcopy performance in healthy subjects reflects the visual-constructional ability and effectiveness of executive functions (Rivera, 2015). Whereas the copy omission indicated inattention or neglect problems, the scores of distorted reproduction reflect visual perceptual distortions.So, this study suggest that the ROCF-copy could be sensitive to specific neuropsychological disorders (Kasai, Ishizaki& Meguro, 2007).

With regard the recall trial scores, the results suggested that the manifestation of differences due to sex are age related, clearly for females memory efficacy occurredamong specific age group (18.01-21) years,Nevertheless, these differences were vanished at other age groups. Partially but not consistently across all age groups, it confirm the findings of Poulton and Moffitt (1994) andPalomo et al., (2013) that there were significant age effects on immediate recall for the ROCFT.An immediate recall trial of the ROCFT can be useful for the assessment of visual memory disturbance and recall deficits.

The findingsalso revealed that the peak performanceof ROCFT tasks (copy and immediate recall) between ages 18-21,it coincide with prior studies suggested that peak deployment of executive functions begin with twenty and early adulthood(Casals-Coll, et al., 2013, Davidson, 2006). There were also age related increase of copy and immediate recallscores but the scores slightly declined at age group 21 and above for both males and females. Finally our study reveal different age effects; this is probably due to the impact of development of cognitive and motor functions. This is the first study of its kind to

provide Egyptian age related norms to ROCF with wide range between 7 and 24 years, including males and females, thus providing the neuropsychologists with a valuable tool in clinical practice based on healthy Egyptians educated subjects. ROCF test needs further researches to investigate the differential performance of various psychopathological clinical samples.

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Appendix 1

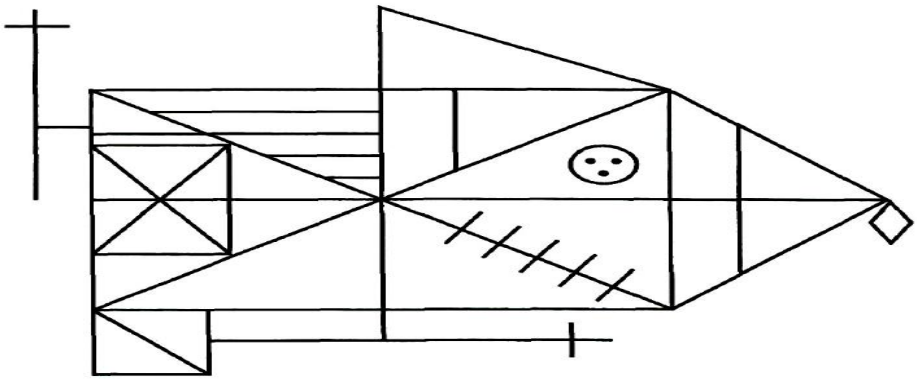

Fig. 1: The Rey Osterrieth complex Figure (ROCF). Drawn from Corwin and Bylsma (1993)

The Osterrieth scoring system

	Correct	Distorted or incomplete but recognizable	Absent or not recognizable
Placed properly	2	1	0
Placed poorly	1	1/2	0

code of participant 26b2	copy							recall					
item	correct		Distorted or					correct		Distorted or			
	properl	poorly	properl	poorly	missed	total		properl	poorly	properl	poorly	missed	total
1. Cross upper left corner, outside of recta	2					2	1	2					2
2. Large rectangle	2					2	2	2					2
3. Diagonal cross	2					2	3	2					2
4. Horizontal midline of (2)	2					2	4	2					2
5. Vertical midline	2					2	5	2					2
6. Small rectangle, within (2) to the left	2					2	6	2					2
7. Small segment above (6)					0	0	7					0	0
8. Four parallel lines within (2), upper left			1			1	8			1			1
9. Triangle above (2), upper right	2					2	9	2					2
10. Small verticle line within (2), below (9)	2					2	10					0	0
11. Circle with three dots, within (2) 11	2					2	11	2					2
12. Five parallel lines within (2) and crossi	2					2	12		1				1
13. Sides of triangle attached to (2) on righ	2					2	13	2					2
14. Diamond attached to (13)	2					2	14		1				1
15. Verticle line within triangle (13), parall	2					2	15					0	0
16. Horizontal line within (13), continuing	2					2	16	2					2
17. Cross attached to lower center	2					2	17		1				1
18. Square attached to (2), lower left	2					2	18	2					2
total	32	0	1	0	0	33		22	3	1	0	0	26

Fig. 2 the excel scoring sheet to minimize the errors of scoring,that was utilized in this study.

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المعايير العمرية لاختبار الشكل راي المعقد لمجموعات عمرية مصرية غير إكلينيكية

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ملخص:

تهدف هذه الدراسة إلى توفير البيانات المعيارية المصرية من اختبار الشكل المعقد ري Rey Osterrieth Complex Figure Test (ROCFT) كاختبار نفسي عصبي غير لفظي؛ معروف ولا يزال استخدامه محدود في الممارسة النفسية السريرية في مصر، بسبب الحاجة إلى معايير عمرية. شارك في الدراسة مجموعة تكونت من خمسمائة وواحد وعشرون شخصاً من العاديين، تتراوح أعمارهم بين ٩ و ٢٤ عامًا ، حيث بلغ عدد الإناث (٢٧٢) أنثى، بمتوسط السن = ١٧,٢٦٨ (٣,٩٣) و(٢٤٩) من الذكور بمتوسط سن = ١٧,١٥٥ (٣,٩٣). تم استقطابهم من الصف الرابع إلى الصف الثاني عشر (العدد = ٢٨٦) ومن طلاب جامعة بنها (العدد = ٢٣٥). كما تم تصنيف العينة إلى شرائح من خمس فئات عمرية (٩-١٢ و ١٢,٠١-١٥ و ١٥,٠١-١٨ و١٨,٠١-٢١ و ٢١,٠١ -٢٤ سنوات)، وتم إعطاء المشاركين الاختبار كجزء من دراسة أكبر تهدف إلى إنشاء بيانات معيارية محلية لبعض الاختبارات النفسية العصبية. حيث تم إعطاء المشارك بطاقة الشكل ري مع ورقة بيضاء بنفس المقاس وذلك لنسخ الشكل بدقة قدر الإمكان، ولم يتم إخبار المشاركين بأن الاختبار ينطوي على تذكرالشكل بعد إتمام عملية النسخ. وقد تم التصحيح وفقا لدقة النسخ التي تعكس المعالجة البصرية المكانية، ودقة الإسترجاع الفوري كمؤشر للذاكرة غير اللفظية الفورية. وقد تم تحليل النتائج للحصول على أدلة تدعم الإكتفاء بالمعايير العمرية. أشارت النتائج إلى أن العمر الزمني وسنوات التعليم يؤثران بصورة طفيفة على درجات دقة النسخ، وأن العمر يؤثر فقط على درجات الاستدعاء الفوري ، ولا يمكن لسنوات التعليم أوالعمر التنبؤ بشكل مستقل عن نتائج نسخالشكل ري المعقد، حيث أظهرت النتائج نموذجاً للتنبؤ، حيث أوضحت العمر الزمني وسنوات التعليم فسرا تباين درجات النسخ. كما اتضح أن العمر يتنبأ بالأداء فقط في مهمة الاستدعاء الفوري. تقدم هذه الدراسة المعايير المصرية المتعلقة بالعمر للأداء على الشكل ري المعقد، كما تقدم بعض الأدلة الإحصائية على أن الفروق بين الذكور والاناث غير دالة بالنسبة لمعظم المجموعات العمرية. مما دعم اشتقاق معايير عمرية مئينية لكل مجموعة عمرية. وبذلك توفر الدراسة لأخصائيي علم النفس العصبي أداة يمكن الاستفادة منها في الممارسة السريرية، ذات معايير مئينية اعتمادا على مجموعات عمرية مصرية عادية ومتعلمة.

الكلمات المفتاحية: الشكل ري المعقد ، علم النفس العصبي ، عينات غير إكلينيكية ، معايير عمرية ، درجات مئينية