IMPLICATIONS OF HANDWRITING IN MOVEMENT DISORDERS AMONG NEUROLOGICAL PATIENTS IN FAYOUM GOVERNORATE, EGYPT.

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ABSTRACT

Background: Common cumulative neurological diseases and their effects on motor control in general and handwriting in particular. This research aims to introduce the fundamental aspects of common neurological disease as the basis for understanding why and how handwriting changes in the presence of disease. **Methods:** This is the prospective research which study changes of handwriting over 30 neurological patients as (Parkinsonism disease, Essential tremor, and Ataxia) Fayoum Governorate. **Results:** Among the study group, the mean age was (55.4±15.8) years, with 22 (73.3%) were males and 8(26.7%) were females. The present study documents that among all neurological cases included in the study, (10%) of them show the moderate change in neglecting some letters, tendency to small letters, and lack of control to punctuate characters. As regards tremor, 50% had moderate to high change. Not adhering to the line of printed moderate change represents 16.7%, and 6.7% shows the moderate change in pressure of writing. Also, this research illustrated that in-between parkinsonism cases (30%) of they show the moderate change in neglecting some letters, lack of control to punctuate characters and not to adhere to the line of printed, also 10% moderate change in the tendency to small letters. As regards tremor, 90% had moderate to high change. **Conclusion:** Rehabilitation programs for handwriting problems in neurology disease patients are likely to be helpful. More extensive randomized studies are needed to confirm these results.

Keywords: Parkinson's disease, Essential tremor, Handwriting**,** Fayoum.

INTRODUCTION

Neurodegenerative disorders are a broad term utilized for an assortment of status which essentially influences the neurons in the humanitarian mind. Neurons are the nuclear units of the sensory system that are utilized to move signals in electrical heartbeats to all the organs in a body. Motor neurons control purposeful muscle movement, for example, composing and take messages from nerve cells in the cerebrum to the muscles. Neurons do not recreate themselves **(Eichhorn, T.E et al., 1996),(Drotar, P et al., 2016)**

Handwriting is perhaps the most imperative practice which is influenced by such disorders. Handwriting is an aftereffect of an intricate organization created by psychological, sensation, and perceptual-engine capacities. Notwithstanding these, visual and sensation discernment, engine arranging, eye-hand coordination, visual-engine joining, smoothness, and manual abilities are included **(Pereira, C.R. et al., 2015**). Extensive changes in the handwriting design are the critical element of Alzheimer's disease (AD), just as Parkinson's disease (PD) and

Spinocerebellar ataxia (SCA). Learning and performing penmanship requires the cooperation of different cerebrum zones, incorporating the cerebral cortex, basal ganglia, and cerebellum. Different highlights of the creative cycle are more powerless than others and may register diagnostic signs (**Pirlo, G. et al., 2015).**

The mechanism of handwriting disability has not been entirely explained, yet it seems, by all accounts, to be inconsequential to the striatal dopaminergic brokenness that happens in neurological sickness (**Ling H et al., 2012).** Indeed, it has been accounted for that levodopa treatment has negligible or no impact on handwriting execution. On the other hand, handwriting, like other programmed abilities, for example, strolling or utterance, could be amended via the impact of various outside visual or hear-able stimuli **(Kang SY et al., 2010),** (**Iansek M, Huxham N and McGinley L, 2006)**.

This is the first study in the neurological department in Fayoum University Fayoyum Governorate, designed to evaluate the usefulness of handwriting changes in a collection of (Parkinsonism disease, Essential tremor, and ataxia) patients who expertise quandary with handwriting and signing.

MATERIAL & METHOD

This is the prospective research which study changes of handwriting over 30 neurological patients as (Parkinsonism disease, Essential tremor, and ataxia) collected from neurology department, faculty of medicine, Fayoum University. All the patient's details are noted initially in the white sheet of paper: Name, Sex, Age, Occupation, Handedness, and Local address. The tools were appointed to examine genus identifying traits in the handwriting paradigm of male and female volunteers were done in **Forensic Medicine Authority, Ministry of Justice**. The existent research was coinciding by the local Ethics board in Fayoum University, and documentary au courant consent was gained of all patients.

Assessment; -

The following factors were assessed by:

1) Neglecting some letters and trend of handwriting (number of states and percentage): ascending, level or descending (titular variable) way of handwriting with esteem to the level of writing.

2) Decreasing size of letters: perpendicular gage (millimeters) of the first and the last in the term and tendency to small letters

3) Tremor of writing and Lack of control to punctuate characters

4) Not adhering to the line.

6) Force of the pressure of writing (**Adriana Ziliotto et al., 2015).**

Instruments used to measure changes in writing:

1. Naked eyes

At first of the examination for the writing, we take a general idea by using naked eyes to examine the neglecting some letters, the tendency to small letters, lack of control to punctuate characters, and the adhering to the print line.

1.2. Magnifiers (lens)

Figure (1): Structure of some magnifiers

Magnifiers depend on the zoom magnifiers (lenses) to identify the shape of strokes. The magnification lenses: simple lenses, lenses double or triple, so there are magnifiers that have different X, where X indicates the amount of zoom or magnification used to examine the tremors.

2. Microscopic examination

In Figure (2), microscopes are a crucial instrument in the writing since it

allows an examiner to view detail not seen with naked eyes or a hand magnifier. This is particularly important in specific examinations to the pressure of writing.

Figure (2): Some microscopes

Statistical Analysis

Data analysis used the Statistical Package of Social Science **(SPSS)** software version 22 in windows 7. Unpretentious depiction analysis in the form of numbers and percentages of qualitative data and arithmetic means as central tendency measurement, standard perversion to measure the dispersion of quantitative parametric data. Quantitative data comprised in the research first tested for normality by One-Sample Kolmogorov-Smirnov test in each study team then inferential statistic tests chosen. For the quantitative one-way **ANOVA** test, compare quantitative measures between more than two independent groups of quantitative information. For qualitative data, the **Chi-square** test was used to compare two of more than two qualitative groups. The **P-value< 0.05** deemed as statistically significant.

RESULTS

Among the research group, the mean age was (55.4±15.8) years, with 22 (73.3%) were males and 8(26.7%) were females. There was a statistically value variation between various neurological diseases regarding age and sex with older age among parkinsonism cases with a p-value of 0.001 and a higher percentage of females among essential tremor disease with a p-value of 0.003 as shown in table (1). The present study documents that among all neurological cases included in the study, (10%) of them show the moderate change in neglecting some letters, tendency to small letters, and lack of control to punctuate characters. As regards tremor, 50% had moderate to high change. Not adhering to the line of printed moderate change represents 16.7%, and 6.7% shows the moderate change in pressure of writing in the table (2).

This research also illustrated that in-between parkinsonism cases (30%) show the moderate change in neglecting some letters, lack of control to punctuate characters and not to adhere to the line of printed, also 10% moderate change in the tendency to small letters. As regards tremor, 90% had moderate to high change. 20% show the moderate change in pressure of writing, as shown in table (3). Table (4) recorded among essential tremors cases; all cases show the simple change in neglecting some letters, tendency to small letters, lack of control to punctuate characters, and not adhering to the line of print. Also, 60% had simple change, and 4% had a moderate change in tremor. Finally, 10% show the simple change in the pressure of writing. While in ataxia cases, all cases show the simple change in neglecting some letters, lack of control to punctuate characters. Also, 80% had a simple change in the tendency to small letters, tremor, and not adhering to the line of print. Finally, 60% show the simple change in pressure of writing, as shown in table (5).

There was a statistically significant diversity with a p-value <0.05 between different neurological diseases with a higher percentage of a moderate change in neglecting some letters, lack of control to punctuate characters, and pressure, and great change in tremors among cases of parkinsonism. On the other hand, there is no statistically significant dispute with p-value >0.05 as regards tendency to small letters and not adhering to the line factor as depicted in table (6) and fig (3). Fig (4), (5), and (6) displayed handwriting changed in some cases of Parkinsonism, Ataxia, and Essential tremor.

Table (1): Comparisons of demographic characters in different study groups.

Variables	Parkinsonism	Essential tremor	Ataxia	P-value
Age (years)	69.3±4.5*	45.5±16.8	51.5±12.6	0.001*
Sex				
Male	8(80%)	4(40%)	10(100%)	0.003*
Female	2(20%)	6(60%)	0(0%)	

Table (2): Frequency of handwriting factors among all neurological diseases.

Variables		Neurological diseases	
		No	**(%)**
Neglecting some letters	Simple	27	90%
	Moderate	3	10%
Tendency to small letters	Simple	27	90%
	Moderate	3	10%
Tremors	Simple	15	50%
	Moderate	6	20%
	High	9	30%
Lack of control to punctuate characters	Simple	27	90%
	Moderate	3	10%
Not adhering to the line of print	No change	1	3.3%
	Simple	24	80%
	Moderate	5	16.7%
Pressure of writing	No change	19	63.3%
	Simple	9	30%
	Moderate	2	6.7%

Table (3): Frequency of handwriting factors among parkinsonism cases.

Variables		Parkinsonism	
		No	**(%)**
Neglecting some letters	Simple	7	70%
	Moderate	3	30%
Tendency to small letters	Simple	9	90%
	Moderate	1	10%
Tremors	Simple	1	10%
	Moderate	2	20%
	High	7	70%
Lack of control to punctuate characters	Simple	7	70%
	Moderate	3	30%
Not adhering to the line of print	No change	1	10%
	Simple	6	60%
	Moderate	3	30%
Pressure of writing	No change	6	60%
	Simple	2	20%
	Moderate	2	20%

Table (4): Frequency of handwriting factors among essential tremor cases.

Variables		Essential tremor	
		No	**(%)**
Neglecting some letters	Simple	10	100%
	Moderate	0	0%
Tendency to small letters	Simple	10	100%
	Moderate	0	0%
Tremors	Simple	6	60%
	Moderate	4	40%
	High	0	0%
Lack of control to punctuate characters	Simple	10	100%
	Moderate	0	0%
Not adhering to the line of print	No change	0	0%
	Simple	10	100%
	Moderate	0	0%
Pressure of writing	No change	9	90%
	Simple	1	10%
	Moderate	0	0%

Table (5): Frequency of handwriting factors among ataxia cases.

Variables		Ataxia	
		No	**(%)**
Neglecting some letters	Simple	10	100%
	Moderate	0	0%
Tendency to small letters	Simple	8	80%
	Moderate	2	20%
Tremors	Simple	8	80%
	Moderate	0	0%
	High	2	20%
Lack of control to punctuate characters	Simple	10	100%
	Moderate	0	0%
Not adhering to the line of print	No change	0	0%
	Simple	8	80%
	Moderate	2	20%
Pressure of writing	No change	4	40%
	Simple	6	60%
	Moderate	0	0%

Table (6): Comparisons of factors of handwriting in different neurological diseases.

Variables		Parkinsonism	Essential tremor	Ataxia	P-value
		No (%)	No (%)	No (%)	
Neglecting some letters	Simple	7(70%)	10(100%)	10(100%)	**0.036***
	Moderate	**3(30%)**	0(0%)	0(0%)	
Tendency to small letters	Simple	9(90%)	10(100%)	8(80%)	0.32
	Moderate	1(10%)	0(0%)	2(20%)	
Tremors	Simple	1(10%)	6(60%)	8(80%)	**0.001***
	Moderate	2(20%)	4(40%)	0(0%)	
	High	**7(70%)**	0(0%)	2(20%)	
Lack of control to punctuate characters	Simple	7(70%)	10(100%)	10(100%)	**0.036***
	Moderate	**3(30%)**	0(0%)	0(0%)	
Not adhering to the line of print	No change	1(10%)	0(0%)	0(0%)	0.215
	Simple	6(60%)	10(100%)	8(80%)	
	Moderate	3(30%)	0(0%)	2(20%)	
Pressure of writing	No change	6(60%)	9(90%)	4(40%)	**0.031***
	Simple	2(20%)	1(10%)	**6(60%)**	
	Moderate	**2(20%)**	0(0%)	0(0%)	

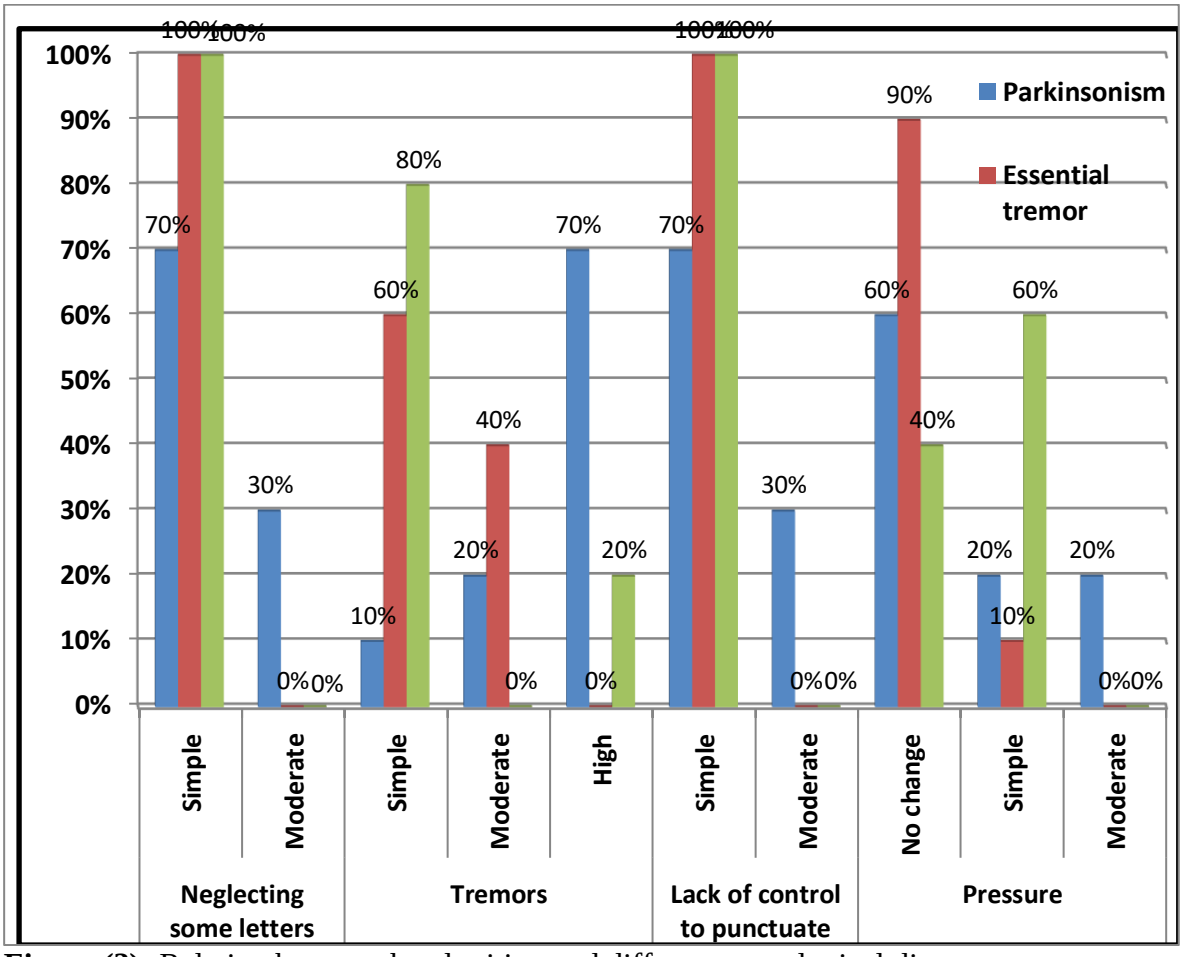

Figure (3): Relation between handwriting and different neurological disease

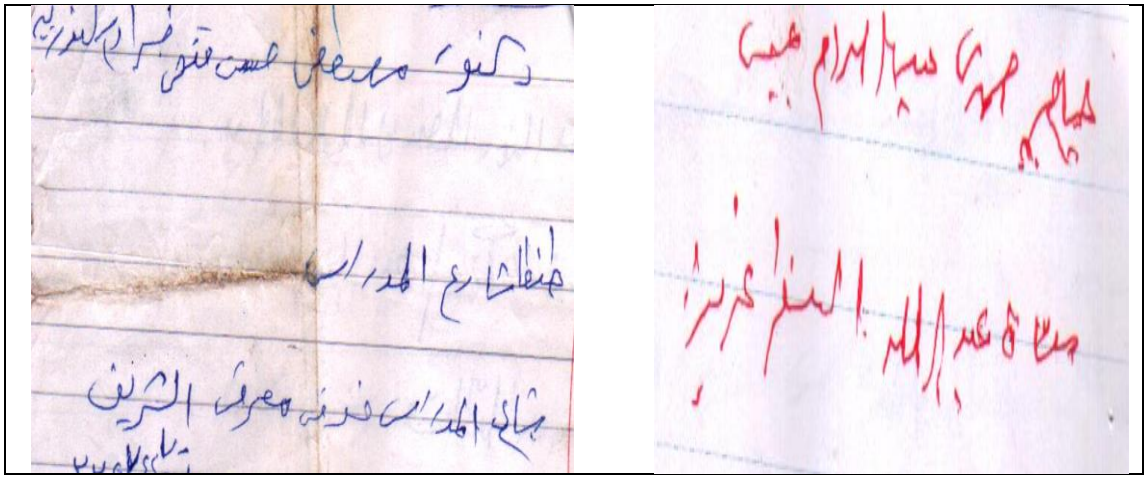

Figure (5): Handwriting changes before **(A)** and after **(B)** in ataxia case.

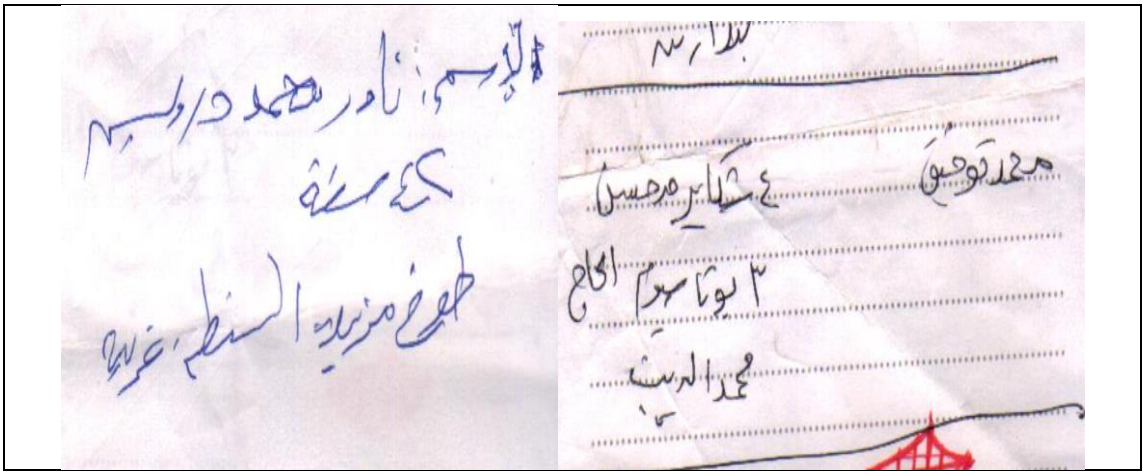

Figure (6): Handwriting changes before **(A)** and after **(B)** in essential tremor case.

DISCUSSION

Scarce neurophysiological research has determined the issue from the point of view of motion analyses in essential tremor (ET), parkinsonism disease (PD) **(Elble, C. et al., 1994) (Ozekmekci G et al., 2005)**, and ataxia. Some researchers found no variation of the motion time for recurrence wrist or upper-limb motion between ET patients and sanitary subjects (**Thomas M al., 2016).**

Most of the patients with PD have handwriting anomalies. Micrographia (strangely small letter size) is the most regularly announced and effectively noticeable handwriting variation from the norm in patients with PD. Reformist micrographia is more attribute of PD, **et al., 2017)** (**Tarver J, 2000**) while others, using the several motion model of the fingers, wrist, or upper-limb, documented that motor achievement levels in ET patients identical to these of PD and variation from uninfected controls, proposing the of existence some degree of bradykinesia in ET (**Montgomery B et al., 2000)** (**Duval A et al ., 2006**) kinematics between patients with PD and ET **(Yu et** though an absence of decrement is all the more usually saw in in Parkinson's addition to conditions. This data may end up being urgent in separating PD from thumping parkinsonism during the beginning phases of the illness **(Thomas et al., 2017)**.

There are a few practical tests for assessing manual execution; be that as it

may, quantitative manual tests for ataxia, particularly those for assessing handwriting, are restricted. Ataxic handwriting with expanded development commotion is portrayed by unpredictable pen tip developments unlimited by the finger or wrist. The seriousness of ataxia is to relate to these unlimited developments **(Fujisawa and Okajima., 2015)**.

Our study shows a statistically significant variation between several neurological diseases regarding age and sex with older age among parkinsonism, which coincides with **(Bower et al., 2004)**, who reported that. The PD diverse with age, extending from approximately 0.02% for persons range from 50 to 60 years of age to 0.09% for those range from 70 to 80 years of age. Also, this research illustrated that in-between parkinsonism cases (30%) of they show the moderate change in neglecting some letters, lack of control to punctuate characters and not to adhere to the line of printed, also 10% moderate change in the tendency to small letters. As regards tremor, 90% had moderate to high change. 20% show the moderate change in pressure of writing **(Pearce, 2008**) explained that arm and hand movements in PD might have minimized amplitudes or hypokinesia. Akinesia points to the lack or minimization of spontaneous movement.

Micrographia is a prevalent expression of parkinsonism comprising all three characters: akinesia, hypokinesia, and bradykinesia. Micrographia may seem like an early indication before the diagnosis of PD. Whistle micrographia is a well-known characteristic of handwriting pressure in PD (**Tucha et al., 2006)**, not all PD patients display micrographia (**Tarver, 1988**). In major-scale expansion research, it predestined that about 10%–15% of PD patients display micrographia.

Weakness prompting a failure to hold the composing tools and moderate pen developments product low pen pressures verses of the composing surface side bound to be related to minimizing engine neuron sickness (for example, amyotrophic horizontal sclerosis [ALS]) than an extrapyramidal infection (for example, PD). Quivery penmanship developments can happen in PD, fundamental quake (ET). Different highlights revealed by Walton in her complete appraisal of PD handwriting incorporate a more noteworthy numeral of pen lifts (about double that old enough equivalent solid subjects) and more prominent fluctuation in stroke extension both inside and through tests, especially through beginning PD patients. Persons with micrographia are incapable of enduring ordinary size letters forming for more than a short time (**Teulings and Stelmach, 1991**).

Essential tremors (ET) cases show the basic change in ignoring a few letters, the propensity to little letters, the absence of control to accentuate characters, and not sticking to the line. Additionally, 60% had basic change, and 4% had a moderate change in the quake. At last, 10% show the basic change in pressing factor. While in ataxia cases, all cases show the straightforward change ignores a few letters, absence of control to intersperse characters. Likewise, 80% had a straightforward change in inclination to little letters, quake, and not clinging to the line. At last, 60% show the straightforward change in pressing factor. The pathophysiology of ET is not completely seen; be that as it may, practical neuroimaging proof has ensnared variations from the norm inside the thalamus and cerebellum (**Bhidayasiri R, 2005) (Byrnes, M. et al., 2005).**

CONCLUSION

Neurological disorders, including PD and ET, may cause deterioration in the handwriting and signature of individuals afflicted with these conditions. Under therapy, with medication, and after surgery, these individuals may recover functionality.

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الملخص العربي

تداعيات الكتابة اليدوية في اضطرابات الحركة بين مرضى الأعصاب في محافظة الفيوم، مصر.

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الأمراض العصبية التراكمية الشائعة وتأثيرها على التحكم الحركي بشكل عام والكتابة بشكل خاص. يهدف هذا البحث إلى تقديم الجوانب الأساسية للأ مراض العصبية الشائعة كأساس لفهم لماذا وكيف يتغير خط اليد في حالة وجود المرض. هذا البحث يدرس التغيرات في الكتابة اليدوية لأكثر من 30 مريضاً من مرضى الأعصاب مثل (مرض باركنسون، الرعاش مجهول السبب، الرنح) في محافظة الفيوم. لقد ظهرت النتائج أن متوسط العمر في مجموعة الدراسة (55.4 ± 15.8) سنة، بواقع 22 (73.3٪) ذكور و 8 (26.7٪) إناث. توثق الدراسة الحالية أنه من بين جميع الحالات العصبية المشمولة في الدراسة، أظهرت (10٪) منهم تغيرًا معتدلًا في إهمال بعض الحروف، والميل إلى الحروف الصغيرة، وعدم التحكم في علامات الترقيم. فيما يتعلق بالرعشة، كان لدى 50٪ تغيرات متوسطة إلى عالية. عدم التمسك بخط التغيير المتوسط المطبوع يمثل 16.7٪ ويظهر 6.7٪ تغير معتدل في ضغط الكتابة. كما أوضح هذا البحث أن بين حالات الشلل الرعاش (30٪) منهم يظهرون تغيرًا معتدلًا في إهمال بعض الحروف، وعدم التحكم في علامات الترقيم وعدم الالتزام بالخط المطبوع، وأيضًا تغير معتدل بنسبة 10٪ في الاتجاه لأحرف صغيرة. فيما يتعلق بالرعاش، 90٪ لديهم تغيرات متوسطة إلى عالية.