Post-COVID-19 Electrophysiological, Cognitive and Psychological Assessment in a Sample of Healthcare Providers in Qena Governorate

Tarek Desoky[a], Mohammed Moslem[a], Rania Ali[a*], Ayman Gamea[a]
[a]Neuropsychiatry Department, Faculty of Medicine, South Valley University, Qena, Egypt

Abstract
Background: The COVID-19 outbreak threatens society globally. Stress and depression are common. Electrophysiological, cognitive, psychological, and covid-19 disease assessments
Objectives: Assessment relationship between cognition, psychological and covid-19 disease.
Patients and methods: 30 patients had covid-19-positive PCR, and 25 healthy controls matched for Sex and Age. Electroencephalogram (EEG) assessed electrophysiological changes, cognitive functions were assessed using Trail Making Test (parts A and B) and Montreal Cognitive Assessment (MoCA), depression and anxiety were assessed using HAM D & A.
Results: No EEG changes after 1 month between cases and controls (p-value=0.099) and after 3 months (p-value=0.293).Follow, neither cases nor controls has EEG changes(p-value=0.630,1.0).Cases and controls differ in trail A(p-value=0.003) after month while after 3 months(p-value=0.123). In the cases, trail A after 1 month is different from trail A after 3 months(p-value=0.001). In controls, trail A after 1 month and 3 months is identical(p-value=0.428). Trail B shows no significant difference between cases and controls after 1 and 3 months(p-value=0.170,0.428)
Cases and controls differ in 1-month MoCA(p-value=0.001). Cases and controls have similar MoCA after 3 months (p-value=0.917). Repeat MoCA after 3 months differs statistically(p-value=0.001,0.896). HAM-A statistically differs between cases and controls after 1 month(p-value=0.005), but not after 3 months(p-value=0.133). Cases and controls differ for HAM A within 1 month and after 3 months (p-value=0.001,0.048). After 1 month, HAM D cases and controls differ (p-value=0.249,0.753).follow cases and controls identical (p-value=0.006,0.188)
Conclusion: Our study shows that SARS-CoV-2 impairs healthcare workers cognition and psyche.
Keywords; COVID-19; Psychological impacts; Cognitive function; Healthcare providers.
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***Correspondence**: raniaali3391@gmail.com
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Introduction

The coronavirus is currently spreading throughout the world (COVID-19). COVID-19 was labelled as pandemic by the World Health Organization (WHO), which monitors global efforts to manage the repercussions. **(World Health Organization et al., 2020).** The scale of the effects is unprecedented, and studies have suggested that it might take a long time for the world to recover **(United Nation et al., 2020).**

Cognitive deficits are a sign of all mental illnesses. High rates of psychological symptoms, such as panic, frustration, suicidal behavior, and post-traumatic stress syndrome, have been reported in the general community following previous COVID outbreaks, independent of viral conditions **(Jeong et al., 2016)**

EEG recordings offer a useful noninvasive way to assess changes in perception, cognition, emotion, and action-related brain activity. They are crucial in the quest to comprehend, identify, and cure a wide range of neurological and psychiatric disorders that result in excruciating human suffering. **(Farrense et al., 2019)**

Health professionals from all across the world are actively working to contain more disease outbreaks brought on by the new COVID-19. Therefore, in our study, we tried to investigate the association between COVID-19 in health workers, and cognitive impairment in healthcare providers in Qena governorate.

Patients and methods

This was a case-control study Carried out at Qena Hospitals, included 30 patients diagnosed COVID-19 disease and another 25 healthy controls subject to the inclusion and exclusion criteria. They were selected from the Qena Hospitals, Egypt from December 2020 to June 2021.

The inclusion criteria included Patients recovering from COVID-19 disease within 1 month (confirmed by negative serial PCR), aged between 20-60 years old and both sexes are included.

Exclusion criteria included patients with other metabolic disorders or conditions that can affect cognition, aged below 20 and above 60 years old, and patients who scored 7 or more on the Hamilton depression rating scale (Hamilton M, 1960), 12 or more in Hamilton anxiety scale.

Prior to being enrolled in this study, all participants provided a written informed agreement, and the research was given the study's institutional ethics committee's approval at the Faculty of Medicine in Qena. (IRB NO; SVU-MED-NAP020-1-20-8-64).

All patients underwent the following:

1- Risk factors such as DM,HTN, smoking and history of previous fits or psychiatric disorders.

2- General, neurological and psychiatric examination.

3- Laboratory tests: PCR Test for COVID-19.

4- Changes in EEG was assessed with an electroencephalogram (Nihon Khoden L5-901 serial 01445, 2008) after 1 month and 3 months of recovery from 19 standard 10/20 electrode locations with linked ear reference **(Homan et al.,1987).**

5- Montreal Cognitive Assessment (MoCA) test: measures 8 cognitive sectors including language ,attention, visuospatial, concentration, memory, orientation, abstraction and calculation. The maximum possible score is 30 points; a score of 25 or below indicates impairment, a score of 26 or above is considered normal. **(Nasreddine et al., 2005).**

6- Trail Making Test (TMT) (Parts A and B): two parts of the Trail Making Test consist of 25 circles distributed over a sheet of paper. Part A assesses visual perception rapidity and psychomotor
rapidity. Part B assesses mental shifting and the subject's attention ability. The score for each part is the number of seconds required to complete the task. Trail A between (28- 33 seconds) is an average and > 78 seconds is deficient. Trail B between (60-84 seconds) is average and > 273 seconds is deficient **(Reitan, 1958).**

7-Hamilton depression rating-17-item version (is the most popular scale for determining how severe depression is in people who have previously been diagnosed with a depressive disorder, scores of 0–7 normal, 8–16 mild depression, 17–23 moderate depression and

scores over 24 are considered severe depression **(Hamilton, 1960).**

8-Hamilton Anxiety Rating Scale (this scale measures the severity of a patient's anxiety, based on 14 parameters, including anxious mood, tension, fears, insomnia, somatic complaints, and behavior at the interview**.(Hamilton, 1959).**

IV. Socioeconomic status: Assessment of the socio-economic status according to Abdel-Tawab socio- economic status scale, this scale consisted of four dimensions, namely, level of education, employment, total family monthly income and the lifestyle of the family**. (Abdel-Tawab, 2012)**

Research outcome measures: Primary (main): Assessment of the relationship between cognitive function and COVID-19 disease. Secondary (subsidiary): Assessment of early complications of COVID-19.

Statistical analysis

Data was analyzed using Statistical Package for Social Sciences (SPSS) (version 26).

Qualitative variables are recorded as frequencies and percentages and compared by the chi-square test or Fisher exact test. Quantitative measure presented as means ± standard deviation (SD) and compared by student *t*- test. P value < 0.05 considered significant.

Results

None of the differences were statistically significant between the studied groups (cases and controls) as regards demographic data (age, sex, occupation, and special habits), The mean age is 28.9±7.3, 28.8±4.4 among cases and controls. Among the participants, there are 60%, 36% males in cases and controls. According to occupation there are(60%,68% doctors, 26.7%,20% nurses, 3.3%,4% radio.worker, 10%, 8% clean workers) in cases and controls.

There are 83.3% and 88% non-smokers among cases and controls, respectively.(**Table.1**).

Table 1. Comparison between studied groups as regard demographic data

Variables		Cases (N = 30)		Control (N = 25)		P-value
Age (years)	Mean	28.9		28.8		0.26
	±SD	7.3		4.4		
Sex	Male	18	60%	9	36%	0.07
	Female	12	40%	16	64%	
Occupation	Doctor	18	60%	17	68%	0.92
	Nurse	8	26.7%	5	20%	
	Radio. Worker	1	3.3%	1	4%	
	Clean worker	3	10%	2	8%	
Special habits	Non-smoker	25	83.3%	22	88%	0.62
	Smoker	5	16.7%	3	12%	

None of the differences were statistically significant (p-value = 0.099) between cases and control as regards EEG changes within 1 month, and there was no statistical significant difference (p-value = 0.293) between cases and control as regards EEG changes after 3 months. Follow up showed no statistical significant difference (p-value = 0.630) between EEG within 1 month and EEG after 3 months in the cases group, and no statistical significant difference (p-value = 1.0) between EEG within 1 month and EEG after 3 months in the control group,(**Table. 2**).

There was a statistically significant difference (p-value = 0.003) between cases and controls as regards Trail A within 1 month. It was 51 ± 27.6 in cases group and 32.7 ± 5.3 in control group, no statistically significant difference (p-value = 0.123) between cases and control as regard trail A after 3 months and with follow up there was a Statistically significant difference (p-value = 0.001) between trail A within 1 month and trail A after

3 months in the case group. It was 51 ± 27.6 within 1 month and 34.3 ± 12.4 after 3 months in cases group. None of the differences were statistically significant (p-value = 0.428) between trail A within 1 month and trail A after 3 months in the control group. (**Table.3**)

Table 2. Comparison between studied groups as regard EEG changes

Variables		**Cases (N = 30)**		**Control (N = 25)**		**P-value**
EEG within 1 month	**Normal**	18	60%	22	88%	0.099
	Diffuse slowing	8	26.7%	3	12%	
	Focal slowing	2	6.7%	0	0%	
	Epileptic	2	6.7%	0	0%	
EEG after 3 months	**Normal**	22	73.3%	22	88%	0.293
	Diffuse slowing	4	13.3%	3	12%	
	Focal slowing	2	6.7%	0	0%	
	Epileptic	2	6.7%	0	0%	
Follow						
	p-value	0.630		1.0		

Table 3.Comparison between studied groups as regard Trail A

Variables		**Cases (N = 30)**	**Control (N = 25)**	**P-value**
Trail A within 1 month	**Mean**	51.0	32.7	0.003
	±SD	27.6	5.3	
Trail A after 3 months	**Mean**	34.3	33.4	0.123
	±SD	12.4	5.2	
Follow	**MW**	222.5	272	
	p-value	0.001	0.428	

None of the differences were statistically significant (p-value = 0.170) between cases and control as regards Trail B within 1 month, there was no statistically significant difference (p-value = 0.482) between cases and control as regards Trail B after 3 months. As regards follow up, none of the differences were statistically significant (p-value = 0.052) between trail B within 1 month and trail B after 3 months in the case group. None of the differences were statistically significant (p-value = 0.969) between trail B within 1 month and trail B after 3 months in the control group,(**Table.4**).

Table 4. Comparative analysis of the study groups with reference to Trail B.

Variables		**Cases (N = 30)**	**Control (N = 25)**	**P-value**
Trail B within 1 month	**Mean**	142.5	101.8	0.170
	±SD	105.1	71.4	
Trail B after 3 months	**Mean**	81.2	96.0	0.482
	±SD	25.1	58.6	
Follow	**p-value**	0.052	0.969	

There was a highly statistically significant difference (p-value < 0.001) between cases and controls as regards MoCA within 1 month. It was 24.4 ± 3.6 in the case group and 26.9 ± 2.9 in the control group, there was no statistically significant difference (p-value = 0.917) between cases and controls as regards MoCA after 3 months. As regards follow up, there was a statistically significant difference (p-value = 0.001) between MoCA within 1 month and MoCA after 3 months in the case group. It was 24.4 ± 3.6 within 1 month and 26.7 ± 3.1 after 3 months in the case group. No statistically significant difference (p-value = 0.896) between MoCA within 1 month and MoCA after 3 months in the control group. (**Table.5**).

Table 5. Comparative analysis of the study groups with reference to MoCA.

Variables		Cases (N = 30)	Control (N = 25)	P-value
MoCA within 1 month	**Mean**	24.4	26.9	< 0.001
	±SD	3.6	2.9	
MoCA after 3 months	**Mean**	26.7	27.3	0.917
	±SD	3.1	2.1	
Follow	**p-value**	0.001	0.896	

There were statistically significant variations (p-value = 0.005) between cases and control as regards HAM A within 1 month. It was 21.1 ± 7 in the case group and 15.8 ± 5.7 in the control group, there was no statistically significant difference (p-value = 0.133) between cases and controls as regards HAM A after 3 months. As regards follow up, there were highly statistically significant variations (p-value < 0.001) between HAM A within 1 month and HAM A after 3 months in the case group. It was 21.1 ± 7 within 1 month and 14.4 ± 5 after 3 months in cases group, there were statistically significant variations (p-value = 0.048) between HAM A within 1 month and HAM A after 3 months in the control group. It was 15.8 ± 5.7 within 1 month and 12.8 ± 4.9 after 3 months in the control group, (**Table.6**).

Table 6. Comparative analysis of the study groups with reference to HAM A.

Variables		Cases (N = 30)	Control (N = 25)	P-value
HAM A within 1 month	**Mean**	21.1	15.8	0.005
	±SD	7.0	5.7	
HAM A after 3 months	**Mean**	14.4	12.8	0.133
	±SD	5.0	4.9	
Follow	**p-value**	< 0.001	0.048	

There were no statistically significant variations (p-value = 0.249), (p-value = 0.753) between studied groups as regards HAM D within 1 month, within 3 months. As regards follow up, There were no statistically significant variations (p-value = 0.006) between HAM D within 1 month and HAM D after 3 months in the case group. It was 12.6 ± 5.3 within 1 month and 8.8 ± 3.9 after 3 months in the case group, There were no statistically significant variations (p-value = 0.188) between HAM D within 1 month and HAM D after 3 months in the control group, (**Table.7**).

Table 7.Comparative analysis of the study groups with reference to HAM D.

Variables		Cases (N = 30)	Control (N = 25)	P-value
HAM D within 1 month	**Mean**	12.6	11.1	0.249
	±SD	5.3	5.6	
HAM D after 3 months	**Mean**	8.8	9.2	0.753
	±SD	3.9	5.4	
Follow	**p-value**	0.006	0.188	

Discussion

The general people has been safeguarded from disease outbreak by taking several precautionary measures, as stopping or reducing taking to the streets, lessening social engagement, putting on masks. As a result of the increasing the need for healthcare, healthcare had to work longer shifts. Wearing personal safety equipment, which causes resentment and breathing difficulties, makes these serious conditions worse. **(Tan et al.,2020)**

This study's primary objective was to look into the association between Covid-19 , and cognitive impairment in healthcare providers in Qena governorate. This case

control study was conducted by Qena Hospitals staff.

The current study showed through analysis of demographic information of the studied groups that the average age is 28.9±7.3, 28.8±4.4 and there are 60%, 36% males in cases and controls, A number of 60%, 68% doctors, 26.7 %, 20% nurses, 3.3%, 4% radio workers, 10 %, 8% clean workers, There is 83.3%, 88% non-smokers among cases and controls respectively. While, the study of **(Surrati et al, (2020)** shows that the majority of participants were aged 20 to 40; 64.5% of them were female; and 76.3% of them were married. 5.6% were emergency department (ER) doctors, 15.8% were nurses, and 52.6% were physicians. Eight responders (10.5%) had recently smoked cigarettes.

In our study we used electroencephalogram on all participants to assess if there EEG changes, we found that there is no significant impact , while in study of **(Pellinen et el.,2020)** in 111 patients, with a mean age 64 years, the most finding of EEG was moderate generalized slowing (57%), 30% with epileptiform abnormalities and 7 % having seizure. This difference may be due to the variable of age and severity of symptoms.

In our study participants were assessed on a range of cognitive tasks by MoCA that showed there is a strong association between COVID-19 affliction and cognitive impairment, our study showed also that COVID-19 cause a deficit in trail A, trail B test especially during the first duration of affliction then improvement occurs.

The outcome of these study concur with a study by a study by **(Becker et al.,2021)** they found high prevalence of cognitive impairment several months after patients had COVID-19 and else in concur with the study of **(Méndez et al., 2020)** that revealed 59% of patients had cognitive impairment in at least one function. This may be explained that exposure to hypoxia of these patients at acute stage of disease lead to neural damage so cognitive impairment occur.

Our results showed that depression and anxiety levels increase among participants and continue for a time Whereby on (HAM-D, HAM-A) assessed on participants we found increase depression and anxiety rate among cases group compared to controls group, this may be due to disruption of neurotransmitters that affected by cytokines that activate of hypothalamic-pituitary-adrenal axis so induce resistance to glucocorticoids.

This study is in agreement of the study of **(Surrati et al., 2020),** that used the HAM to analyze anxiety and depression, They found that 27.7% of participants were depressed and 72.8 were anxious Also, **(Giusti et al., 2020)** demonstrated that percentage of stress, anxiety, and depressed people were 88 participants (26.8%), 103 people (31.3%), and 113 participants (34.3%). 121 people (36.7%) reported post-traumatic stress symptoms.

Conclusion

Our research shows that among healthcare workers, the high probability of SARS-CoV-2 exposure results in significant cognitive and psychological impairment. The necessity of encouraging psychological emergency among medical workers during this pandemic disease is highlighted by this study.

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