



## The Effect of COVID-19 on Attention of Neurocognitive Functions in Healthcare Professionals

COVID-19'un Sağlık Çalışanlarında Nörobilişsel Fonksiyonlardan Dikkat Üzerine Olan Etkisi

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### ABSTRACT

**Aim:** This research aims to investigate the long-term effect of coronavirus disease 2019 (COVID-19) on attention, which is considered an essential neurocognitive function.

**Material and Method:** In this cross-sectional study, the study group consisted of healthcare professionals who are currently working at the Training and Research Hospital and who have had COVID-19 disease before. One hundred seventy-four individuals (female: 109, male: 65) met the inclusion criteria. The General Health Questionnaire was used for general health status, and the Attention Deficit section of the Adult Attention Deficit Hyperactivity Scale was used to assess attention deficit.

**Results:** Of the 174 healthcare workers who had COVID-19, 113 (64.9%) had attention deficit. Attention deficit was mild in 47 (41.5%), moderate in 40 (35.39%), and severe in 26 (23%) (mean±std= 2.36 ±0.64, 6.85 ±2.31, 14.96 ±3.94, respectively). When attention deficit and general health status were evaluated in terms of gender, smoking, hospitalization, pulmonary infection, and vaccination status, no significant relationship was found. Attention and general health status were worse in those who did not receive treatment during the COVID-19 period (p=0.009, p=0.029, respectively).

**Conclusion:** In our study, a high rate of attention deficit was detected in healthcare workers who had COVID-19. In addition, attention deficits were more common in those who did not receive treatment during the COVID-19 period than in those who did. Attention deficits can lead to severe problems for people who do risky work, such as healthcare workers. For this reason, necessary research should be done, and necessary precautions should be taken.

**Keywords:** COVID-19, neurocognitive functions, attention deficit

### ÖZ

**Amaç:** Bu araştırma, koronavirüs hastalığı 2019 (KOVİD-19)'un temel bir nörobilişsel işlev olarak kabul edilen dikkat üzerindeki uzun vadeli etkisini araştırmayı amaçlamaktadır.

**Gereç ve Yöntem:** Kesitsel tipte olan bu araştırmanın çalışma grubunu, halihazırda Eğitim ve Araştırma Hastanesi'nde görev yapan ve daha önce KOVİD-19 hastalığı geçiren sağlık profesyonelleri oluşturdu. Yüz yetmiş dört kişi (kadın: 109, erkek: 65) dahil edilme kriterlerini karşıladı. Genel sağlık durumu için Genel Sağlık Anketi, dikkat eksikliği değerlendirme için Erişkin Dikkat Eksikliği Hiperaktivite Ölçeği'nin Dikkat Eksikliği bölümü kullanıldı.

**Bulgular:** KOVİD-19 geçiren 174 sağlık çalışanının 113'ünde (%64,9) dikkat eksikliği vardı. Dikkat eksikliği 47'sinde (%41.5) hafif, 40'ında (%35.3) orta, 26'sında (%23) şiddetliydi (sırasıyla ortalama±std= 2.36 ±0,64, 6.85 ±2.31, 14.96 ±3.94). Dikkat eksikliği ile genel sağlık durumu cinsiyet, sigara içme, hastanede yatma, akciğer enfeksiyonu ve aşılanma durumu açısından değerlendirildiğinde anlamlı bir ilişki bulunamadı. KOVİD-19 döneminde tedavi görmeyenlerde dikkat ve genel sağlık durumu daha kötüydü (sırasıyla p=0.009, p=0.029).

**Sonuç:** Çalışmamızda KOVİD-19 geçiren sağlık çalışanlarında yüksek oranda dikkat eksikliği tespit edildi. Ayrıca KOVİD-19 döneminde tedavi görmeyenlerde, tedavi görenlere göre dikkat eksikliği daha fazla görüldü. Dikkat eksikliği, sağlık çalışanları gibi riskli işler yapan kişilerde ciddi sorunlara yol açabilmektedir. Bu nedenle gerekli araştırmalar yapılmalı ve önlem alınmalıdır.

**Anahtar Kelimeler:** KOVID-19, nörobilişsel işlevler, dikkat eksikliği

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**Başvuru Tarihi/Received:** 03.09.2023

**Kabul Tarihi/Accepted:** 01.10.2023



## INTRODUCTION

Coronavirus disease 2019 (COVID-19) is caused by coronavirus 2 (SARS-CoV-2), which emerged in Wuhan, China, and affected the whole world(1). When it first appeared, it was thought to affect only the respiratory tract because it caused fever, cough, and shortness of breath, but later, it was reported that it affected all other systems and could be fatal(2). It is estimated that over 2 million people have died due to COVID-19(3). It has caused chronic sequelae in some body functions in survivors(4,5). One of these chronic sequelae is neurocognitive impairment. Studies have shown that regardless of the medical severity of the disease, some neurocognitive deficits were detected in COVID-19 survivors, even three months later(6).

Neurocognitive impairment can reduce quality of life, lead to impaired functioning, and result in accidents. Therefore, its recognition and treatment are essential. While evaluating neurocognitive functions, attention/working memory, executive function, motor function, processing speed, learning, and memory areas are evaluated(7). Attention deficits are at the root of cognitive difficulties(8). Considering that healthcare workers perform vital work, they must be attentive and sound for both their health and the community's health. Attention deficits may result in significant problems for those who perform risky work, such as healthcare workers. Therefore, early recognition and treatment are essential—no study in the literature evaluating attention deficits in healthcare workers years after COVID-19. The frequency of attention deficits due to the long-term effect of COVID-19 in healthcare workers, who are at the forefront of the fight against diseases and are more exposed, is unknown. If the frequency of attention deficits in healthcare workers who have had COVID-19 is known, necessary measures can be taken against them. Case studies reported that this condition was reversed with treatment in people who did not have attention deficits before and attention deficit symptoms after COVID-19(9). In this study, we aimed to investigate the frequency of attention deficits in healthcare workers who had COVID-19.

## MATERIAL AND METHOD

The study was conducted in accordance with the Declaration of Helsinki. Ethical approval for the study was obtained with the permission of the Karamanoğlu Mehmetbey University Ethics Committee, dated June 23, 2021, and numbered 04-2021/08.

In this cross-sectional study, the study group consisted of healthcare workers working at Training and Research Hospital who had previously had COVID-19 disease. A total of 265 healthcare workers who had COVID-19 agreed to participate in the study. People with any chronic illness or psychiatric history before COVID-19 were excluded from the study. Alcohol users were also excluded. Thirty-four people with any chronic disease before COVID-19

were excluded from the study. Thirty-three people who had previously received psychiatric treatment and 24 alcohol users were excluded because they could be confounders for attention deficit. One hundred seventy-four people (female: 109, male: 65) met the inclusion criteria. Individuals who met the inclusion criteria were informed about the purpose and characteristics of the study, and their informed consent was obtained. After sociodemographic data were recorded, the General Health Questionnaire was used for general health status, and the Attention Deficit section of the Adult Attention Deficit Hyperactivity Scale was used to assess attention deficit.

### Assessment Of Attention Deficit

In the 48-item scale developed by Turgay (1995) and arranged according to a 5-point Likert-type scale, the adult is asked to rate their cognitions and behaviors(10). The scale includes three subsections: "Attention Deficit Section", "Hyperactivity/Impulsivity Section," and "ADHD Related Characteristics and Problems Section". In this study, the scores of the "Attention Deficit Section" were evaluated. The scale was translated into Turkish and adapted, and a validity and reliability study was conducted by Günay et al(11). The Cronbach's alpha coefficient of the total score was reported as 0.96. The administration time of the scale, which is a self-report, is approximately 10 minutes. Those who score 1-3 points on the test have a mild attention deficit; those who score 3.01–10.99 points are deemed moderate attention deficit; and those who score higher than 11 points are considered to have a severe attention deficit.

### General Health Assessment (GHQ-12)

It is a screening tool to detect common mental disorders and general psychiatric well-being(12). It is a valid and reliable tool(13). It is a four-point Likert scale consisting of 12 items. It includes anxiety and depression, social dysfunction, and loss of confidence. Each item is scored between 0 and 3. The total score varies between 0 and 36. A high score indicates that health is negatively affected. Cronbach's alpha coefficient was reported as 0.78.

### Statistical Analysis

All data were analyzed using the SPSS 25.0 package program in a computer environment. The q-q plot, skewness, and kurtosis evaluated the conformity of continuous data to the normal distribution. In analyzing normally distributed continuous variables, the Student T test was used for independent paired groups, and one-way ANOVA analysis was used for more than two independent groups to determine the difference between groups. For pairwise comparisons in multiple groups, post-hoc Bonferroni correction was used when variances were homogeneously distributed, and post-hoc Dunnett T3 was used when variances were not. Pearson A correlation test was used to determine the relationship

between continuous variables when normality conditions were met. The interpretation of the correlation coefficient was evaluated as follows: weak=0–1,49; medium=0–50-0,69; high=0–70–1,00(14). In regression analysis, Durbin-Watson evaluated autocorrelation, and multicollinearity was assessed by tolerance and VIF. The statistical significance level was accepted as  $p < 0.05$ .

## RESULTS

Analysis of sociodemographic data showed that 109 (62.6%) of 174 patients were female, and 65 (37.4%) were male. The mean age was  $36.55 \pm 10.11$  years. The body mass index (BMI) was  $25.52 \pm 3.93$ . Participants were 77 physicians (44.3%) and 97 other health professionals (55.7%); 154 (88.5%) had been vaccinated; 20 (11.5%) had not been vaccinated; 31 (17.8%) smoking (Table 1).

**Table 1: Sociodemographic data of healthcare workers with COVID-19**

	n	%
<b>Gender</b>		
Female	109	62.6
Male	65	37.4
<b>Job</b>		
Doctor	77	44.3
Other health personnel	97	55.7
<b>Cigarette</b>		
Yes	31	17.8
No	143	82.2
<b>Vaccination status</b>		
Yes	154	88.5
No	20	11.5
<b>Type of vaccine</b>		
1;Pfizer-BiontechVaccine	79	51.3
2;Sinovac-CoronavacVaccine	49	31.8
3;Biontech+Coronavac	26	16.9
<b>Mean(±Std, Deviatin)</b>		
Age	36.55 (±10.11)	
BMI	25.52(±3.93)	
Education (Years)	17.33(±4.21)	

Of the 174 healthcare workers, 113 (64.9%) had attention deficit. Attention deficit was mild in 47 (41.5%), moderate in 40 (35.39%), and severe in 26 (23%) (mean±std= 2.36 ±0.64, 6.85 ±2.31, 14.96 ±3.94, respectively) (Table 2).

**Table 2: Degree of attention deficit in healthcare workers with COVID-19**

	n	Mean	SD	*p	p1 (1-2)	p2 (1-3)	p3 (2-3)
ADS				<0.001β	<0.001β	<0.001β	<0.001β
Minimum	47	2.36	0.64				
Medium	40	6.85	2.31				
Severe	26	14.96	3.94				

\*Oneway Test, βDunnnett T3, COVID-19; Coronavirus disease 2019, ADS; Attention Deficit Score

When attention deficit and general health status were evaluated in terms of gender, smoking, hospitalization, pulmonary infection, and vaccination status, no significant relationship was found. Attention and general health status were worse in those who did not receive treatment during COVID-19 ( $p=0.009$ ,  $p=0.029$ , respectively) (Table 3).

**Table 3: Comparison of attention deficit and general health status with other parameters**

		n	Mean	Std. Deviation	p*
<b>Gender</b>					
ADS	Female	109	4.94	6.041	0.133
	Male	65	3.62	4.824	
GHQ-12	Female	109	13.95	7.906	0.337
	Male	65	12.75	8.047	
<b>Cigarette</b>					
ADS	Yes	31	3.52	4.972	0.311
	No	143	4.65	5.771	
GHQ-12	Yes	31	13.29	6.669	0.869
	No	143	13.55	8.230	
<b>Hospitalization</b>					
ADS	Yes	10	2.90	5.109	0.373
	No	164	4.54	5.671	
GHQ-12	Yes	10	10.70	7.273	0.252
	No	164	13.68	7.985	
<b>Pulmonary involvement</b>					
ADS	Yes	37	4.30	4.496	0.855
	No	137	4.49	5.925	
GHQ-12	Yes	37	14.11	7.389	0.605
	No	137	13.34	8.122	
<b>Received treatment for COVID-19</b>					
ADS	Yes	99	3.41	4.281	0.009
	No	75	5.81	6.839	
GHQ-12	Yes	99	12.36	7.478	0.029
	No	75	15.01	8.361	
<b>Vaccinated against Covid-19</b>					
ADS	Yes	154	4.19	5.268	0.235
	No	20	6.40	7.850	
GHQ-12	Yes	154	13.31	7.897	0.358
	No	20	15.05	8.451	

\*Student T Test, COVID-19; Coronavirus disease 2019, GHQ-12;General Health Assessment-12, ADS; Attention Deficit Score

## DISCUSSION

In our study, most healthcare workers who had COVID-19 had an attention deficit (64.9%). Attention deficits were severe in 23% of those with them. Those who did not receive treatment during COVID-19 had more attention deficits and a worse general psychological health status than those who received treatment. A limited number of studies in the literature evaluate attention deficits in healthcare workers who have undergone COVID-19. In a meta-analysis, attention deficit (27%) ranked third after fatigue and headache among more than 50 adverse effects of COVID-19(15). If attention deficit is not treated, it can lead to many significant personal, social, and economic problems that can harm the overall quality of life(16,17).

Although deficits in attention and other neurocognitive functions have been reported in short-term follow-ups during the COVID-19 pandemic, data on neurocognitive functions in long-term follow-ups are still lacking(6). Therefore, our study may contribute to the literature. COVID-19 is thought to cause long-term neuropsychiatric disorders, including attention deficits, by triggering chronic inflammation and abnormal immune responses(18,19). The etiology of the neurocognitive consequences of COVID-19 infection is likely multifactorial. Neurocognitive impairment may have occurred due to cerebrovascular disease due to the procoagulation state caused by the virus. Even social isolation may have negatively affected cognitive functions. Cognitive functions may be affected due to hypoxia. In a study conducted on patients with acute respiratory distress syndrome (ARDS), it was reported that attention and other cognitive functions were lower in survivors even 1 year later. This may also be true for COVID-19, which affects the respiratory tract(20). In our study, although three years have passed, attention deficit and general psychological status were still worse in those who did not receive treatment during the COVID-19 period compared to those who received treatment, indicating that chronic inflammation continues even years after surviving COVID-19.

It has been reported that proinflammatory cytokines secreted by COVID-19 may hypoxia contribute to cognitive decline(21). Severity of psychiatric symptoms after recovery from COVID-19 is proportional to the severity of systemic inflammation during acute infection(22). This points to the importance of anti-inflammatory treatment during COVID-19 disease.

Despite some studies, the etiologic mechanisms of attention deficit in adulthood are still not fully understood; it is considered heterogeneous and multifactorial(23). Therefore, a multidisciplinary approach is required to find the etiopathogenesis, diagnosis, and treatment. Attention deficits may result in significant problems for those who perform risky work, such as healthcare workers. Attention deficits affect work performance and other routine tasks such as driving and housework(24). In cases where it is not diagnosed and treated, work performance may decrease, and traffic accidents may occur. Therefore, early recognition and treatment are essential. Case studies showed an increase in attention deficit symptoms after having COVID-19, and this condition was reversed with treatment in people who did not have attention deficit before(9).

Our finding of a high rate of attention deficit years after COVID-19 may encourage new studies in the future. Our results need to be supported by large-scale studies.

There were some limitations in our study. Firstly, the article lacks a comprehensive comparison between

cognitive functions in healthcare professionals before and after COVID-19 infection. This comparison is crucial for establishing the extent of the impact and should be addressed or explicitly acknowledged as a limitation. Since our cross-sectional study does not provide information about which transformations people who describe cognitive impairment will experience in the future. Longitudinal studies are needed in this situation. Secondly, we could not form a healthy control group because very few healthcare workers did not have COVID-19. Case-control studies, including a healthy control group, may provide more straightforward information.

## CONCLUSION

As a result, a high rate of attention deficit was found in healthcare workers who had COVID-19 in our study. In addition, attention deficits were more common in those who did not receive treatment for COVID-19. Although attention deficit is quite common in people who have had COVID-19, it is an underestimated condition. Attention deficit can result in severe problems for people who do risky work, such as healthcare workers. When attention deficit is suspected, research should be done, and necessary precautions should be taken for its treatment when the diagnosis is made.

## ETHICAL DECLARATIONS

**Ethics Committee Approval:** Ethical approval for the study was obtained with the permission of the Karamanoğlu Mehmetbey University Ethics Committee, dated June 23, 2021, and numbered 04-2021/08.

**Informed Consent:** All participants in the study provided informed consent and written permission to publish their data.

**Referee Evaluation Process:** Externally peer-reviewed.

**Conflict of Interest Statement:** The authors have no conflicts of interest to declare.

**Financial Disclosure:** The authors declared that this study has received no financial support.

**Author Contributions:** All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

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