IS THERE ANY DIFFERENCE IN THE INCIDENCE RATE OF COVID-19 INFECTION BETWEEN RIGHT- AND LEFT-HANDERS?

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ABSTRACT

Introduction*: Geschwind-Behan-Galaburda hypothesis states that the high intrauterine levels of testosterone impede the growth of certain regions of the left hemisphere, which leads to the right hemisphere language dominance and an increase of left-handedness. Simultaneously, the higher levels of testosterone suppress the development of the thymus. In that case, is there any difference in the incidence of Coronavirus (COVID-19) infection between right- and left-handed individuals?*

Materials and methods: *This retrospective study conducted in a public hospital in Istanbul consists of patients who have been diagnosed with COVID-19 disease because of positive laboratory findings and have been asked for a chest computerized tomography (CT) for the possibility of pneumonia. One hundred forty-three COVID-19 patients, aged between 19 and 89 years, were included in our study, 85 of them were males and 58 were females. The healthy control group consisted of 359 people (180 males and 179 females) and their ages ranged between 18 and 88 years. The determination of left-handedness was made by asking which hand was used when writing. The left-handedness rates in COVID-19 patients and the healthy control group were determined. The findings were evaluated statistically.*

Results: *The left-handedness rate of COVID-19 patients was 29% in males and 26% in females. In the healthy control group, these rates are 21% and 18%, respectively. The difference between the two groups is statistically very significant ($p<0.001$).*

Conclusion: *Our results support the Geschwind-Behan-Galaburda hypothesis, which expresses the negative effect of left-handedness on the immune system via the thymus.*

Keywords: *Covid-19, handedness, incidence, Geschwind-Behan-Galaburda hypothesis.*

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Introduction

Coronavirus (COVID-19) disease caused 81.9 million people to be infected and more than 1.8 million deaths worldwide by the end of December 2020. It is essential to isolate and treat patients with accurate and rapid diagnosis in this pandemic disease[1]. Bourassa et al. found that left-handedness was higher in males than in females[2]. It is seen that left-handedness is 1-2% higher in males[3]. Frequent left-handedness in boys and twins may be attributed to testosterone elevation[4]. Geschwind-Behan-Galaburda hypothesis states that the high intrauterine levels of testosterone impede the growth of certain regions of the left hemisphere, which leads to the right hemisphere language dominance and an increase of left-handedness[5, 6]. Simultaneously, the higher levels of testosterone suppress the development of the thymus. The thymus gland has an important function in the immune system[5, 7].

In that case, is there any difference in the incidence of COVID-19 infection between right- and left-handed individuals? In the current literature, there are no studies on this subject yet.

Materials and methods

This retrospective study conducted in a public hospital in Istanbul, consists of patients who have been diagnosed with COVID-19 disease because of positive laboratory findings and have been asked for a chest computerized tomography (CT) for the possibility of pneumonia. One hundred forty-three COVID-19 patients, aged between 19 and 89 years, were

included in our study, 85 of them were males and 58 were females. The healthy control group consisted of 359 people (180 males and 179 females) and their ages ranged between 18 and 88 years.

Informed consent was obtained from the participants. The determination of left-handedness was made by asking which hand was used when writing. The left-handedness rates in COVID-19 patients and the healthy control group were determined. The findings were evaluated statistically. A chi-square test was used to compare the independent group rates. If the p-value is below 0.05, the results are considered statistically significant.

Results

In our study, the rate of male patients in the Covid-19 patient group was 59.4%, and the rate of female patients was 40.6%. The average age was 46 years in the healthy control group and 50 years in COVID-19 patients. The average age of COVID-19 patients appears to be higher. In a COVID-19 case, as presented in figures 1-3, the initial chest X-ray may be negative, but on the axial CT image, there may be bilateral peripheral consolidations with ground-glass and honeycombs patterns in the lungs.

The left-handedness rate of COVID-19 patients was 29% in males and 26% in females. In the healthy control group, these rates are 21% and 18%, respectively. When the gender difference was not taken into account, the left-handedness ratio was 28% in COVID-19 patients and 19% in the healthy normal group (Table 1). The differences between the two groups are statistically very significant ($p<0.001$). Moreover, in both groups, the rate of left-handedness is observed to be 3% higher in males than in females.

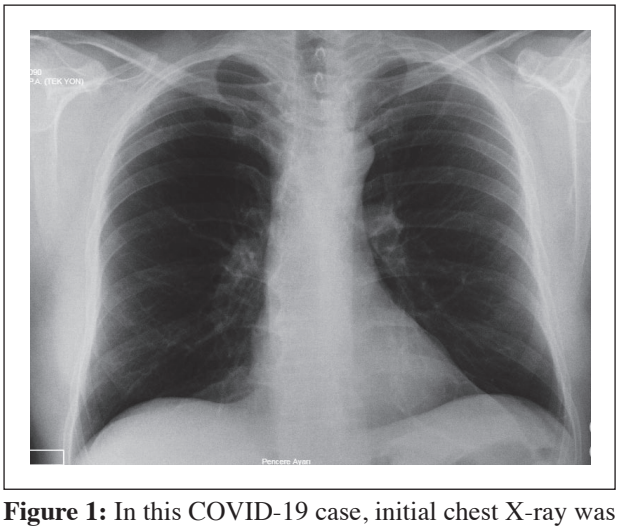

Figure 1: In this COVID-19 case, initial chest X-ray was negative.

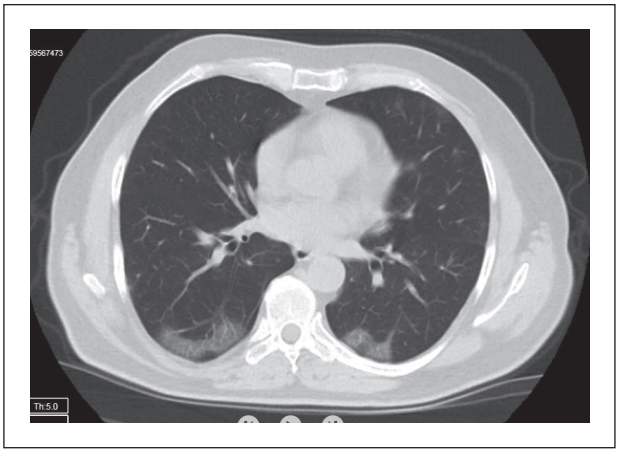

Figure 2: Axial CT image displays two foci of ground-glass opacities in the lungs.

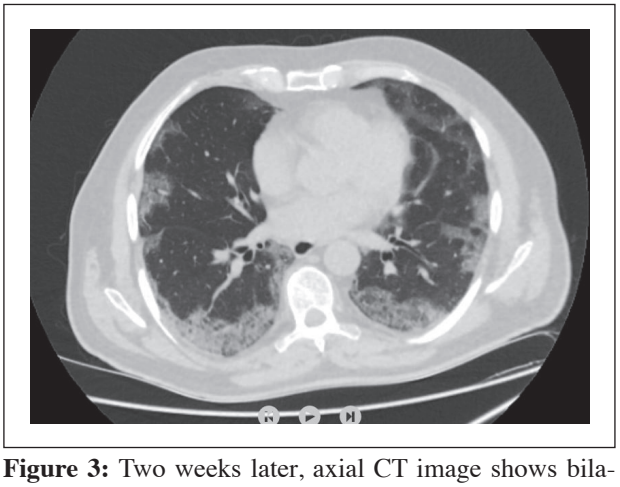

Figure 3: Two weeks later, axial CT image shows bilateral peripheral consolidations with ground-glass and honeycombs patterns.

GROUP	Gender	n	Left-Handers	%	Total n	Left-Handers	%	P value
Covid-19 patients	Male	85	25	29	143	40	28	P<0.001
	Female	58	15	26				
Healthy control group	Male	180	37	21	359	70	19	
	Female	179	33	18				

Table 1: Left-handedness rates in COVID-19 patients and the healthy control group.

Discussion

In our study, we found that the rate of left-handedness was higher in COVID-19 patients than expected in the healthy population.

Bourassa et al. found that left-handedness was higher in males than in females[2]. It is seen that left-handedness is 1-2% higher in males[3]. In our study, the rate of left-handedness in males was 3% more than in females. While Geschwind and Galaburda report that right-handed people have typ-

ical (normal) but left-handed atypical (abnormal) dominance[6], many researchers have reported that left-handedness is associated with certain psychiatric conditions such as autism, mental retardation, and schizophrenia (8-10). Also, Geschwind and Behan observed a higher rate of left-handedness in patients with migraine and myasthenia gravis compared to controls[11].

The cerebrospinal fluid spaces (CFS) contain the superficial cerebral sulci, Sylvian fissures, the 3rd ventricle, the 4th ventricle, and both lateral ventricles[12, 13]. Ozdikici reported that the right hemisphere had a higher CFS measurement value in the right-handers and the left hemisphere had a higher CFS measurement value in the left-handers[14].

Geschwind-Behan-Galaburda hypothesis states that the high intrauterine levels of testosterone impede the growth of certain regions of the left hemisphere, which leads to the right hemisphere language dominance and an increase of left-handedness[5, 6]. Frequent left-handedness in boys and twins may be attributed to testosterone elevation[4]. The higher levels of testosterone suppress the development of the thymus[5, 7]. The thymus gland has an important function in the immune system. A faulty thymus will lead to defects in the immune system, which is crucial for the body's defense against foreign substances. Lymphocytes recognize foreign substances and attack them. Many lymphocytes reside in the thymus. If the development of the thymus was hindered, the lymphocytes would also be hindered. Perhaps, they would be unable to recognize foreign matter. The elimination of T lymphocytes reacting to self-antigens is probably impaired, which in turn determines autoimmune reactions later in life[15-17].

COVID-19 disease caused 81.9 million people to be infected and more than 1.8 million deaths worldwide by the end of December 2020. It is essential to isolate and treat patients with accurate and rapid diagnosis in this pandemic disease[1].

Lauren et al. found that on the day a person started experiencing actual symptoms of COVID-19, the average false-negative rate was 38% in polymerase chain reaction (PCR) test[18]. Because of the primary involvement of the respiratory system, chest CT is recommended even before symptom onset in suspected COVID-19 cases. Chest CT draws attention with its high sensitivity and specificity rates in COVID-19 pneumonia[19]. Typical chest CT findings of COVID-19 pneumonia include bilateral peripheral consolidations involving predominantly the lower lung lobes, ground-glass opacities, and small honeycomb interlobular septal thickening[20]. In this study, the radiological images of one COVID-19 patient were presented in figures 1-3.

In our study, the average age of COVID-19 patients was 4 years more than the control group. When the gender difference was not taken into account, the left-handedness ratio was 28% in COVID-19 patients and 19% in the healthy normal group. The difference between the two groups is statistically very significant ($p<0.001$). Moreover, in both groups, the rate of left-handedness is observed to be 3% higher in males than in females. It is also an interesting finding that most of the 143 Covid-19 patients (59.4%) were male in this work. In our work, there is an important difference in the incidence of COVID-19 infection in favor of left-handers among the right- and left-handers. In the current literature, there are no studies on this subject yet.

Conclusion

Our results show that the rate of left-handedness in COVID-19 patients is significantly higher than that of the healthy control group. Therefore, we support the Geschwind-Behan-Galaburda hypothesis, which expresses the negative effect of left-handedness on the immune system via the thymus.

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