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COVID-19

Masked face recognition in patients with relapsing–remitting multiple sclerosis during the ongoing COVID-19 pandemic

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Abstract

Background Face and facial expression recognition abilities have been frequently evaluated in the assessment of social cognition disorders in patients with MS. Investigation of the effect of new difficulties emerging in the field of face recognition with the widespread use of masks during the ongoing COVID-19 pandemic on patients with MS may make new contributions to the literature.

Material and methods The study included 44 patients with relapsing–remitting MS (RRMSp) and 51 controls who were matched to the case group in terms of age and education level. The Benton face recognition test-short form (BFRT-sf), Beck Depression Inventory, a close-ended 13-item survey on face recognition difficulties due to mask use during the pandemic was administered to all groups.

Results In the RRMSp, the mean disease duration was 8.2 ± 5.6, the mean EDSS score was 1.2 ± 1.0, and the mean MOCA test score was 27.23 ± 2.08. The mean BFRTsf was 19.9 ± 2.4 in the RRMSp and 21.6 ± 1.8 in the healthy controls.Twenty-five percent of RRMSp and 4% of the healthy controls required people to remove their masks to be able to recognize their faces. Improvement in face recognition difficulty over time was reported as 80% in the healthy controls and 34% in the RRMSp.

Conclusion RRMSp had worse performance in masked face recognition and required removal of the facial masks more often than healthy controls to recognize the faces. RRMS patients did not show as much improvement in recognizing masked faces over time according to the onset of the pandemic as healthy controls.

Keywords Masked face recognition · Multiple sclerosis · COVID-19 pandemic · Face mask · Social cognition

Introduction

Multiple sclerosis (MS) is a chronic inflammatory disease that affects the central nervous system. Damage to myelin sheaths and oligodendrocyte cells causes many symptoms and signs in patients with MS. These findings may be in the form of deterioration of motor, sensory, balance, and continence areas, as well as cognitive dysfunction and affective disorders [1–3]. Social cognition disorders have also been evaluated in patients with MS [4, 5]. Face recognition is one of the prerequisites for social interaction in our daily lives. Undoubtedly, the task of perceiving emotional facial expression, which is frequently used in evaluating social cognition, cannot be considered separate from the evaluation of face identification. It is also known that these two functions share some common pathways in the brain [6, 7].

During the ongoing COVID-19 pandemic, everyone started to use facial masks to prevent the spread of the disease. Covering the lower parts of the face with a mask will undoubtedly prevent the use of face recognition strategies adopted routinely. Carragher et al. showed that surgical face masks significantly impair human face recognition performance [8]. In routine daily life, a healthy adult predominantly uses holistic processing that is sensitive to the distance of facial features to each other and their configuration [9]. In a study conducted online to evaluate the effect of mask usage on the face recognition skills of healthy adults during the COVID-19 pandemic through an online assessment, evidence showed that holistic processing was not useful in recognizing masked faces; instead, feature-based face recognition processing was useful [10]. Besides, Ferrari et al. hypothesize that long-term use of facemasks will affect experience-dependent synaptic plasticity on face related information [11].

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The Benton face recognition test-short form (BFRT-sf) has been used to evaluate facial recognition difficulties in patients with multiple sclerosis (MS) in different studies [12–14]. Although the results vary, it has been reported that patients with MS had lower BFRT scores than their peers [12–14]. As far as we know, there is not any study investigating masked face recognition in MS patients. We aimed to determine the differences, if any, of masked face recognition in patients with RRMS from healthy controls.

Materials and methods

Study participants

The study included 44 patients aged over 18 years, who had been following up in neurology outpatient clinics between March 2021 and May 2021 in four centers with a diagnosis of RRMS made according to the 2017 revised McDonald criteria [15], and 51 healthy controls matched to the patient group in terms of age and education level, who were selected from hospital staff and relatives of other patients who presented to the outpatient clinic and gave the impression of being cognitively and linguistically competent. All patients had MRI before the diagnosis of RRMS, but MRI was not performed for this study; so lesion locations of the patients were not evaluated in the study and were not included in the inclusion or exclusion criteria. The scope of the study was explained to each participant, and they all provided written informed consent for involvement in the study. Ethics committee approval was obtained from the local ethics committee (19.01.2021, 2021/010).

The disease severity of the patients with MS included in the study was determined using the Expanded Disability Status Scale (EDSS) [16]. RRMS patients who are less likely to have a severe cognitive impairment, who can walk, and have an EDSS score of 4 or below were included in the study. To evaluate responses to all the questions in our questionnaire (Table 1), participants who described difficulty recognizing a masked face at least once during the pandemic were included. In addition, patients who had an attack within 30 days and participants with a corrected visual acuity worse than 20/50 were not included in the study.

Study design and procedures

The detailed sociodemographic and disease data of the patients were recorded. Global cognitive efficiency was evaluated using the Montreal Cognitive Assessment (MOCA) test for the RRMS group only. In this test, it is possible to score between 0 and 30, and higher scores are associated with better cognition. A score of <21 in the test is considered cognitive dysfunction [17, 18]. The Benton face recognition test-short form (BFRT-sf) was administered to all the participants [19]. In this test, the subject is shown six photographs of the same unfamiliar face and asked to match different photographs of the same face. Some trials include views of the face taken from different angles, different facial expressions, or under different lighting conditions (minimum score = 0-maximum score = 27 for short form). A higher score indicates better face recognition performance. As another factor that could affect face recognition ability, the presence of depression was evaluated using the Beck Depression Inventory (BDI) [20]. This tool consists of 21 items and provides a score ranging from 0 to 63. A score of ≥ 15 on BDI was considered the presence of depression.

Lastly, all the participants completed the "Survey on Face Recognition Difficulties due to Mask Use during the Pandemic" developed by two authors of the study (STA, MKK) (Table 1). With this survey, we aimed to evaluate how many familiar people the participants had seen per day, with which people they experienced difficulties in face recognition, compensation methods they used to overcome these difficulties, and the effect of difficulties in masked face recognition on their daily lives.

Statistical analysis

All statistical analyses were performed using SPSS 23 for Windows v. 11.5 software package (SPSS Inc., Chicago, IL). For descriptive data, quantitative variables were expressed as mean ± SD (min–max), while qualitative variables were expressed as percentage values. Mean values were compared with Student's *t* test if the normal distribution assumptions were met, and Mann–Whitney *U* test otherwise. In the same way, the relationship between two categorical variables was compared with the chi-square or Fisher's exact test; Spearman's correlation test or Pearson's correlation test was used to testing the relationship between variables. The significance level was set at $p < 0.05$.

Results

The study included 44 RRMS patients aged over 18 years and 51 healthy controls. Thirty-six RRMS patients (81.8%) were using disease-modifying medications: The disease-modifying drugs used by the patients are shown in Table 2. While the mean EDSS score of 36 patients using DMT was 1.42 ± 0.2, it was 0.33 ± 0.2 in 8 patients not using DMT ($p = 0.007$). The demographic data of the groups, scores of MOCA, BFRT-sf, and BDI are shown in Table 3. Employment rate was 54.5% in the RRMS group and 84.3% in the healthy controls ($p = 0.002$). Mean BFRT-sf score

Table 1 Survey on face recognition difficulties due to mask usage during the pandemic

Survey items	
1. How many familiar people have you seen per day during the pandemic?	
• 0 to 5	
• 5 to 10	
• ≥ 10	
1. Have you ever been unable to recognize the face of someone you normally see almost every day while he/she was wearing a mask? (Family members, business, and housemates, etc.)	
Yes	No
2. Have you ever been unable to recognize someone you would normally see at least 2–3 times a week while he/she was wearing a mask? (Neighbors, shopkeepers, relatives, etc.)	
Yes	No
3. Have you ever been unable to recognize someone you would normally see every 2–3 weeks who was wearing a mask? (Doctor, rarely seen friends and relatives, etc.)	
Yes	No
4. Have you ever been unable to recognize someone you would normally see less than once a month while they were wearing a mask? (Distant relatives, acquaintances living in another city)	
Yes	No
5. When I am unable to recognize a person wearing a mask, paying attention to their eyes allows me to recognize them	
Agree	Disagree
6. When I am unable to recognize a person wearing a mask, I need to look at their hairstyle or head accessories (hat, headscarf, necklace, earrings, glasses) more carefully in order to recognize them	
Agree	Disagree
7. When I am unable to recognize a person wearing a mask, I need to hear their voice in order to recognize them	
Agree	Disagree
8. When I am unable to recognize a person wearing a mask, I need to look at their clothes more carefully in order to recognize them	
Agree	Disagree
9. When I am unable to recognize a person wearing a mask, I need to look at their gait, posture, and body shape in order to recognize them	
Agree	Disagree
10. I have asked a person to remove their mask because I was unable to recognize them	
Agree	Disagree
11. Do you think you have improved at recognizing people wearing masks since the beginning of the pandemic?	
Yes	No
12. Does difficulty recognizing masked people affect your daily life?	
Yes	No

Table 2 Disease-modifying treatment (DMT) being used in RRMS group

DMT	*N* (%)
Fingolimod	7 (15.9)
Interferon beta-1a	6 (13.6)
Interferon beta-1b	5 (11.4)
Dimethyl fumarate	4 (9.1)
Glatiramer acetate	4 (9.1)
Teriflunomide	3 (6.8)
Natalizumab	5 (11.4)
No DMT	8 (18.2)

was 19.9 + 2.4 in the RRMS group and 21.6 + 1.8 in the healthy control group; the difference was important, statistically ($p < 0.001$). The demographic data of the groups, scores of MOCA, BFRT-sf, and BDI are shown in Table 3. Employment rate was 54.5% in the RRMS group and 84.3% in the healthy controls ($p = 0.002$). Mean BFRT-sf score was 19.9 + 2.4 in the RRMS group and 21.6 + 1.8 in the healthy control group; the difference was important, statistically ($p < 0.001$).

Table 4 presents the detailed data obtained from the questionnaire for masked face recognition difficulties in RRMS group and healthy controls. Fifty percent of RRMS patients and 11.8% of healthy controls met 0–5 familiar people per day, and 15.9% of RRMS patients and 46.2% of healthy control met 5–10 familiar people per day during pandemic; RRMS patients met less people than controls; the difference was important statistically ($p < 0.001$).

Twenty-five percent of RRMS patients and 3.9% of healthy controls described the need the person to remove

Table 3 Demographic and clinical characteristics of the participants

Variable	RRMS ($n=44$)	Control ($n=51$)	p value
Sex (F/M) n (%)	33/11 (75/25)	35/16 (68.6/31.4)	0.492*
Age (years)			
Mean ± SD	35.6 ± 8.4	35.1 ± 7.5	0.872**
Median (min–max)	35 (25.0–59.0)	35 (24.0–57.0)	
Education level (years)			
Mean ± SD	12.7 ± 4.0	13.0 ± 4.0	0.597***
Employed/unemployed, n	24/20	43/8	**0002***
(%)	(54.5/45.5)	(84.3/28.6)	
Marital status			
Married/single, n	36/8	41/10	0.860*
(%)	(81.8/18.2)	(80.4/19.6)	
Disease duration (years)			
Mean ± SD	8.2 ± 5.6	N/A	
(min–max)	(1.0–25.0)		
EDSS score			
Mean ± SD	1.2 ± 1.0	N/A	
Median (min–max)	1.0 (0.0–4.0)		
Attack no			
Mean ± SD	3.61 ± 3.27		
(min–max)	(1–15)		
MOCA test			
Mean ± SD	27.23 ± 2.08	N/A	
Median (min–max)	(22–30)		
BFRT-sf			
Mean ± SD	19.9 ± 2 .4	21.6 ± 1.8	**< 0.001*****
(min–max)	(14.0–25.0)	(19.0–26.0)	
BDI			0.293**
Mean ± SD	11.8 ± 7.4	10.6 ± 7.4	
(min–max)	(0.0–36.0)	(0.0–34.0)	

Values presented as mean ± SD and median (min–max). *RRMS* relapsing remitting multiple sclerosis; *F* female, *M* male; *EDSS* extended disability status scale; *MOCA* Montreal cognitive assessment; *BFRT-sf* Benton face recognition test-short form; *BDI* Beck Depression Inventory. *Pearson's chi-square test; **Mann–Whitney *U* test; ***Student's *t* test

Statistically significant values are shown in bold type

her/his mask to recognize masked faces ($p=0.003$). Moreover, 34% of RRMS patients and 80% of healthy controls got better over time for recognizing masked faces ($p<0.001$). Table 5 shows results of correlation analysis between BFRT-sf score and other parameters. There was moderate positive correlation between BFRT-sf and MOCA test scores ($R=0.387$, $p=0.009$). Furthermore, BFRT-sf scores and education years also showed moderate positive correlation ($r=0.371$, $p=0.013$). Age, attack numbers, EDSS scores, and score of Beck Depression Inventory did not have any relationship with BFRT-sf score.

Discussion

It has been stated that the tasks of face identification and facial expression recognition from photographs, which are frequently applied to evaluate social cognition in patients with MS require the proper use of holistic face recognition processing [21, 22]. Recognizing masked faces in daily life is a task where feature-based processing is more prominent. Based on this information, the current study aimed to contribute to the literature by comparing the performance of patients with relapsing–remitting MS (RRMS) and healthy controls in terms of face recognition ability using an additional method different from the tests employed in previous studies, i.e., investigating the task of recognizing masked faces, which has become part of our daily lives as a result of ongoing COVID-19 pandemic.

A survey which was developed by two authors of the study (STA, MKK) was used to evaluate difficulties in recognizing masked faces in both RRMS patients and healthy control peers. RRMS patients had more difficulty recognizing masked faces than healthy controls, as expected, in the study. Both RRMS patients and healthy controls used strategies including looking carefully at the person's eye and head regions, the clothing, the posture and gait, and hearing the person's voice, in similar degrees, to overcome the difficulty to recognize masked faces. However, 25% of RRMS patients and 4% of the healthy controls required people to remove their masks to be able to recognize their faces. Although the difficulty in recognizing masked faces improved over time in the healthy control group according to the onset of the pandemic, RRMS patients did not show such an advance. Furthermore, masked facial recognition was better in those with higher education years and higher cognitive test scores in the RRMS group.

General cognitive skills and the presence of depression in patients with MS have been shown to affect facial processing skills [13, 23–25]. Since the MOCA scores of the patients in the RRMS group were within normal limits and the BDI scores of the RRMS patients and the healthy control groups were similar, we cannot attribute the difference between the two groups to cognitive impairment or depression.

In previous studies, social cognition skill was often evaluated using the tasks of facial expression recognition from photographs or videos and naming the expression verbally [24–26]. In most of these studies, validated facial recognition tests, which require face identification, as well as facial expression recognition, were evaluated together. Undoubtedly, the task of perceiving emotional facial expressions cannot be considered separate from the evaluation of face identification. It is also known that these two functions share some common pathways in the brain,

Table 4 Analysis of responses to the "survey on face recognition difficulties due to mask usage during the pandemic"

	Total group			DMT use status in RRMS group			Disease duration in RRMS group		
	RRMS (***n*** **= 44**) ***n*** **(%)**	Control (*n* = 51) *n* (%)	*p*	DMT (+) (*n* = 36) *n* (%)	DMT(-) (*n* = 8) *n* (%)	p	< 5 (*n* = 19)	> 5 (*n* = 25	***p***
Q1. How many familiar people have you seen per day during pandemic? 0–5 5–10 > 10	22 (50) 7 (15.9) 15 (34.1)	21.4 (11.8) 6 (46.2) 39 (39.5)	< 0.001*	19(52,.7) 10 (27.8) 7 (19.4)	3 (37,5) 5 (62,5) 0 (0)	0.124**	10(52.6) 7(36.8) 2(10,5)	12 (48) 8 (32) 5 (20.)	0.694**
Frequency of meeting people whose face is not recognized and its impact on daily life									
Q2. Difficulty recognizing people almost seen every day (Agree)	1 (2.3)	2 (3.9)	0.559*	1 (2.8)	0 (0)	0.818*	0 (0)	1 (4)	0.568*
Q3. Difficulty recognizing people seen 2–3 times a week (Agree)	5 (11.4)	5 (9.8)	0.805**	5 (13.9)	0 (0)	0.347*	1 (5.3)	4 (16)	0.270**
Q4. Difficulty recognizing people seen every 2–3 weeks (Agree)	7 (15.9)	13 (25.5)	0.253**	6 (16.7)	1 (12.5)	0.625*	3 (15.8)	4 (16)	0.657**
Q5. Difficulty recognizing people seen less than once a month (Agree)	41 (93.2)	47 (92.2)	0.583*	33 (91.7)	8 (100)	0.539*	19 (100)	22 (88)	0.174**
Tactics of dealing with face recognition difficulty									
Q6. Looks carefully at the eye region (Agree)	36 (81.8)	44 (86.3)	0.553**	28 (77.8)	8 (100)	0.171*	16 (84.2)	20 (80)	0.519**
Q7. Looks carefully at the head region (Agree)	13 (29.5)	10 (19.6)	0.260**	13 (36.1)	0 (0)	NA	4 (21.1)	9 (36)	0.230**
Q8. Needs to hear the person's voice (Agree)	16 (36.4)	21 (56.8)	0.631**	16 (44.4)	0 (0)	NA	9 (47.4)	7 (28)	0.186**
Q9. Looks carefully at the clothes (Agree)	8 (18.2)	16 (31.4)	0.140**	8 (22.2)	0 (0)	0.171*	3(15.8)	5(20)	0.519*
Q10. Looks carefully at posture and gait (Agree)	16 (36.4)	15 (29.49	0.471**	15 (41.7)	1 (12.5)	0.124*	9 (47.4)	7 (28)	0.186**
Q11. Needs the person to remove his/her mask (Agree)	11 (25)	2 (3.9)	0.003*	11 (25)	0 (0)	0.078*	6 (31.6)	5 (20)	0.380**
Get better over time for recognizing masked faces									
Q12. Increased success in recognizing masked faces (Yes)	15 (34.1)	41 (80.4)	< 0.001**	12 (33.3)	3 (37.5)	0.562*	8 (42.1)	7 (28)	0.328**

RRMS relapsing remitting multiple sclerosis; *HC* healthy control; *Q* question. *p* value < 0.05 considered statistically significant. *Fisher's exact test, ** Pearson's chi-square test, disease-modifiying therapy *DMT*

Statistically significant values are shown in bold type

Table 5 Results of correlation analysis in the RRMS group

	R	*p*
Age	− 0.236	0.118*
Education	**0.371**	**0.013****
Disease duration	− 0.273	0.73*
Number of attacks	− 0.165	0.284*
EDSS score	− 0.216	0.153*
MOCA test score	**0.387**	**0.009***
BDI	0.126	0.416*

RRMS relapsing remitting multiple sclerosis; *EDSS* extended disability status scale; *MOCA* Montreal cognitive assessment; *BFRT-sf* Benton face recognition test-short form; *BDI* Beck Depression Inventory. *Spearman's correlation analysis, **Pearson's correlation analysis

Statistically significant values are shown in bold type

and the fusiform gyrus is active in both tasks [6, 7]. However, in some studies, impairment was found only in facial expression recognition [27], while others reported problems with both facial expression recognition and face identification [12]. In addition, some researchers also reported that patients with MS performed similarly to their peers in both tasks and they did not have any significant social cognition disorder [21, 28, 29].

The most commonly used strategy, which was used more than 80% of our RRMS patients and healthy controls, to overcome facial recognition difficulty, was looking carefully at the eye region. The least used strategy in the healthy control group was to ask the person to remove their mask to recognize them in contrary RRMS patients.

There is an interesting study that evaluated the perception of facial expression with a method called "face puzzle", in

which facial videos were split horizontally below eye level, and the patients with RRMS were asked to match the eye video at the top of the screen with the corresponding one of the four lips videos at the bottom of the screen [30]. In this process, the patients only tried to match the lower and upper parts of the face (implicit emotion recognition task) without naming the expressions. The patients were also asked to name the emotional expression in the videos where the whole face was seen (explicit emotion recognition task) in that study. The asked facial recognition was better in those with higher results of that study revealed that while more participants with RRMS failed the implicit task compared to their healthy peers, they performed similarly to their peers in the explicit task, suggesting holistic face processing had been using by the RRMS patients. Similar results have also been reported [28–30]. The implicit emotion recognition task is an assessment in which feature-based face recognition processing is at the forefront, as in the task of recognizing masked faces we evaluated in our study. Freud et al. reported that to recognize masked faces during the COVID-19 pandemic, feature-based face recognition processing was more useful than holistic processing, in healthy people [10].

The reason why the difficulty in recognizing masked faces in the RRMS group did not improve over time might due to the lower number of employees and the people met each day in the group. Therefore, contrary to healthy controls, patients with RRMS could not have developed compensatory strategies over time. The MS brain might be incapable of adapting to the process. Ferrari et al. suggested that owing to structural and synaptic encoding systems, wearing facemasks results in functional and structural modifications in multiple brain regions and promotes induction of distinct form of synaptic plasticity in healthy brains [11]. In fact, synaptic plasticity failure in animal model of MS, experimental autoimmune encephalomyelitis (EAE), has been shown previously; moreover, Flippo et al. claimed that alteration of crosstalk between the immune and the nervous systems, modulating the induction of synaptic plasticity and neurotransmission, could be interfered by inflammatory lesions in MS and might cause cognitive impairment [31]. We thought that multiple brain lesions in our MS patients might impaired the development of synaptic plasticity and resulted in failure of being better in time for recognizing masked faces. During the pandemic, RRMS patients were at a more disadvantage in the task that requires feature-based processing. Developing cognitive rehabilitation programs for RRMS patients in recognition of masked faces will be beneficial in this and future pandemic processes.

In the correlation analysis performed in the RRMS group, we observed that the BFRT-sf scores showed a moderate, positive correlation with education level and MOCA test scores. It has been previously stated that performance in such complex visual perception tests in patients with MS have been parallel to general cognitive abilities [16]. Therefore, the correlation of BFRT-sf with the MOCA test scores was expected. Some studies have reported that face and facial expression recognition performances occasionally showed a negative correlation with parameters related to disease severity, such as EDSS score and disease duration [14, 32]. However, other researchers have emphasized that in patients with MS, the distribution of lesions is more important than parameters showing disease severity in the evaluation of such cognitive functions [33]. In our study, we could not find any relationship between parameters showing disability severity and BFRT-sf scores; this may be related to low sample size and/or EDSS levels in the RRMS group, which was equal to or lower than 4. Since the MRI lesion locations of the patients were not evaluated in our study, we cannot comment on this issue.

Limitations

Our findings may be insufficient for defining social cognition disturbances of RRMS patients since we used a survey, based only on the patient's statement, instead of masked face recognition tests. However, due to pandemic conditions, we decided to avoid taking longer time evaluations in order not to prolong the time that the patients would spend in the hospital. For the same reason, we also did not evaluate the recognition of facial expressions. Moreover, we did not perform the MOCA test in the healthy control group with the same caution. Since the number of patients that we could reach under pandemic conditions was limited, the number of patients in the study was low. The inclusion of only patients with EDSS levels ≤ 4 in this study made it impossible to evaluate the association of severe disability with difficulty in recognizing masked faces. We think that the reason for the low EDSS levels of our patients might have resulted from the fact that these patients could come to their control visits more easily under pandemic conditions. For the same reason, the number of patients not receiving DMT was as high as 18% and the mean EDSS was low. Moreover, we did not perform MRI to the participants; therefore, the relationship between masked faces recognition difficulty and MRI lesion localization could not be evaluated in our study. Lastly, due to relatively low sample size in the RRMS group, results of the study should be interpreted with caution.

Conclusion

The widespread use of facemasks during the ongoing pandemic has created a new challenge in face recognition. We found that patients with RRMS had worse performance in masked face recognition and required removal of the facial masks more often than healthy controls to recognize the faces. Moreover, RRMS patients did not show as

much improvement in recognizing masked faces over time as healthy controls from the start of the pandemic. These findings show that the patients with RRMS expressed widespread difficulties in masked face recognition tasks where the utilization of feature-based processing skills is at the forefront. Multiple brain lesions in MS might impair the development of synaptic plasticity and result in failure of being better in time for recognizing masked faces. Our results should be confirmed with further researches including more patients.

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Author contributions **Müge Kuzu Kumcu:** Conceptualization, Investigation, Formal analysis, Data Curation, Writing-Original Draft, Writing-Review and Editing, Visualization.

Sabiha Tezcan Aydemir: Conceptualization, Investigation, Data Curation, Writing-Review and Editing, Visualization.

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Availability of data and material The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Code availability It is not necessary to use any software application for the current study.

Declarations

Ethics approval This study was performed in line with the principles of the Declaration of Helsinki. Approval was granted by the Ethics Committee of Lokman Hekim University, Ankara, Turkey (Reference number: 2021004) 19.01.2021, 2021/010).

Consent to participate Informed consent was obtained from all individual participants included in the study.

Consent for publication The authors affirm that human research participants provided informed consent for publication of the data.

Conflict of interest/Competing interests The authors declare no competing interests.

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