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Frequency of Intradialytic Hypotension Seen in Nutritional Changes Due to the COVID-19 Pandemic in Chronic Hemodialysis Patients: A Retrospective Study

Kronik Hemodiyaliz Hastalarında COVID-19 Pandemisi Nedeniyle Beslenme Değişikliklerinde Görülen İntradiyalitik Hipotansiyon Sıklığı: Retrospektif Çalışma

Yağmur AKBAL DEMİRCİ[a], Vacide AŞIK ÖZDEMİR[a], Ekrem KARA[b]

[a]Recep Tayyip Erdoğan University Faculty of Health Sciences, Department of Nursing, Department of Internal Medicine Nursing, Rize, Türkiye
[b]Recep Tayyip Erdoğan University Faculty of Medicine, Department of Internal Medicine, Rize, Türkiye

ABSTRACT Objective: This study aimed to investigate the frequency of intradialytic hypotension (IDH) in chronic hemodialysis patients following changes made in the nutritional protocol during the coronavirus disease-2019 (COVID-19) epidemic. **Material and Methods:** This retrospective study was conducted with 30 patients who received hemodialysis treatment in a dialysis unit before and during the pandemic periods (2019-2020). The dates December 2019 before the pandemic and December 2020 after the pandemic were selected. Laboratory parameters recorded during patient follow-up were evaluated. Paired sample t-test, Wilcoxon and correlation test were used to evaluate the data. **Results:** The mean age of the patients participating in the study was 62.60±17.79, and 66.7% were male. There was a significant difference between the frequency of IDH in patients before the pandemic (3.24±2.93) and during the pandemic period (4.55±3.36) ($p<0.05$). There were significant differences in systolic, diastolic, and mean arterial pressure values, serum urea, creatinine, hemoglobin, and bicarbonate the pre-pandemic and pandemic one-month periods ($p<0.05$). Furthermore, there was a positive and significant correlation between the amount of ultrafiltration and the frequency of IDH during the COVID-19 pandemic ($r=0.446$, $p<0.05$). **Conclusion:** The increased frequency of IDH in patients receiving hemodialysis treatment during the COVID-19 pandemic was associated with non-adherence to their diets.

Keywords: COVID-19; hypotension; renal dialysis; nursing care; nutritional status

ÖZET Amaç: Bu çalışmada, koronavirüs hastalığı-2019 [coronavirus disease-2019 (COVID-19)] salgını sırasında beslenme protokolünde yapılan değişiklikler sonrasında kronik hemodiyaliz hastalarında intradiyalitik hipotansiyon (İDH) sıklığının araştırılması amaçlanmıştır. **Gereç ve Yöntemler:** Retrospektif olarak yapılan bu araştırma, pandemi öncesi ve pandemi dönemlerinde (2019-2020 yıllarında) bir diyaliz ünitesinde hemodiyaliz tedavisi gören 30 hasta ile yapıldı. Pandemi öncesinde Aralık 2019 pandemi sonrasında da Aralık 2020 tarihleri seçildi. Hasta takipleri sırasında kaydedilen laboratuvar parametreleri değerlendirildi. Verileri değerlendirmek için bağımlı örneklem t-testi, Wilcoxon ve korelasyon testi kullanıldı. **Bulgular:** Araştırmaya katılan hastaların yaş ortalaması 62,60±17,79 olup, %66,7'si erkekti. Hastaların pandemi öncesi (3,24±2,93) ile pandemi döneminde (4,55±3,36) İDH sıklığı arasında anlamlı fark vardı ($p<0,05$). Pandemi öncesi ve pandemi döneminde sistolik, diyastolik ve ortalama arter basıncı değerlerinde, serum üre, kreatinin, hemoglobin ve bikarbonatta anlamlı farklılıklar vardı ($p<0,05$). Ayrıca, COVID-19 pandemisi sırasında ultrafiltrasyon miktarı ile İDH sıklığı arasında pozitif ve anlamlı bir korelasyon vardı ($r=0,446$, $p<0,05$). **Sonuç:** COVID-19 pandemisi sırasında hemodiyaliz tedavisi gören hastalarda İDH sıklığının artması, hastaların diyetlerine uymamalarıyla ilişkili bulunmuştur.

Anahtar Kelimeler: COVID-19; hipotansiyon; böbrek diyalizi; hemşirelik bakımı; beslenme durumu

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Correspondence: Yağmur AKBAL DEMİRCİ
Recep Tayyip Erdoğan University Faculty of Health Sciences, Department of Nursing, Department of Internal Medicine Nursing, Rize, Türkiye
E-mail: yagmur.akbal@erdogan.edu.tr

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Intradialytic hypotension (IDH), with a prevalence ranging from 10% to 70%, is one of the most serious complications of chronic hemodialysis (CHD) treatment.[1,2] The Kidney Disease: Improving Global Outcomes (KDIGO) guidelines define IDH as a symptomatic drop in mean arterial pressure (MAP) of <10 mmHg or a drop of <20 mmHg in systolic blood pressure.[3] In addition to blood pressure, accompanying clinical signs and symptoms are also important in the diagnosis of IDH. Significant symptoms include abdominal and chest pain, yawning, stretching, anxiety, nausea or vomiting, muscle cramps, restlessness, dizziness, syncope, and sweating.[4] IDH can lead to various cardiovascular-related mortalities, including myocardial infarction, and requires immediate intervention.[5] Nursing care for IDH includes interventions such as discontinuing ultrafiltration (UF), administering isotonic saline solution, placing the patient in a Trendelenburg position, reducing pump speed, lowering dialysate temperature, providing massage, and early termination of hemodialysis (HD).[6]

Factors contributing to IDH include intravascular hypovolemia, acetate dialysis solution, use of antihypertensive medications, diabetic neuropathy, tissue ischemia, coronary artery disease, hypoalbuminemia, severe anemia, high body mass index, advanced age, UF faster than refilling rate, and elevated dialysate temperature.[7,8] Another significant cause of IDH is nutrition during dialysis.[9] Consuming food during dialysis leads to the accumulation of splenic and hepatic blood in the abdominal region, resulting in decreased venous return and hypotension. This process typically takes about 2 hours.[10] While some countries support oral nutrition during HD sessions, others do not support it due to its negative effects on postprandial hemodynamics.[11] A study by Rao indicated that pre-HD nutrition provided better dialysis adequacy and urea clearance compared to nutrition during HD.[12] Conversely, another study found that patients who received high-protein nutritional support during HD did not experience symptomatic hypotension and reported positive views on nutrition during HD.[13] IDH has both physical and psychological effects on patients. In patients with IDH, negative dialysis experiences, decreased quality of life, and inadequate toxin removal due to interruption of treatment result in poor toxin removal.[13,14] In addition to all these negative effects, nausea, headache, and fatigue occur in patients during dialysis, making it difficult for patients to adapt to the dialysis process.[15,16] All these results reveal the importance of IDH management, which is among the acute complications of dialysis, the provision of nursing care when patients encounter this complication, and strategies on how to reduce the risk factors that may arise for this complication. Preventing IDH will allow patients to complete the dialysis process safely and prevent complications that may arise due to IDH.

Before the coronavirus disease-2019 (COVID-19) pandemic, oral nutrition was administered during HD sessions for patients receiving CHD treatment in our country and region. However, with the onset of the pandemic, oral nutrition during HD sessions was discontinued in line with the recommendations of the Ministry of Health and the Turkish Society of Nephrology as a precaution to prevent transmission. The aim of this study is to evaluate the effect of the oral nutrition protocol applied during CHD sessions before and during the COVID-19 pandemic on the frequency of IDH.

Research Question

- Has there been a change in the IDH monitoring of patients during the COVID-19 period?

MATERIAL AND METHODS

STUDY DESIGN, SAMPLE AND ETHICS COMMITTEE APPROVAL

This retrospective study was completed in 2019 and 2020 with 30 patients who continued dialysis in good health before and after the pandemic. There were a total of 36 patients in the dialysis center where the study was conducted. In the https://www.openepi.com/Menu/OE_Menu.htm calculation, the sample size was calculated to reach 33 patients with a 95% confidence interval. However, due to the death of 4 patients and the transfer of 2 patients to another dialysis center during the study period, the study was completed with 30 patients. In determining the study period, the month of December

2019 (before the COVID-19 pandemic), when oral nutrition was allowed to be given freely during HD sessions in the center where the research would be conducted, and December 2020 (during the COVID-19 pandemic), when oral nutrition was not given during HD sessions, were selected. Here, the purpose of choosing the same months during the study period was to prevent patients from being affected by seasonal climatic conditions. Written informed consent was obtained from the patients, which included a detailed explanation of the objectives of the study and the methods to be used. An ethics committee approval was obtained from Recep Tayyip Erdoğan University Faculty of Medicine Non-Interventional Clinical Research Ethics Committee (date: March 2, 2023; no: 2023/47). Additionally, the study was conducted in accordance with the rules of the Declaration of Helsinki.

DATA COLLECTION

Within the scope of data consistency and recording quality, the data were scanned by the researchers and recorded in the statistical program. Since the research was conducted on HD patients and healthy patients were included in the research, blood pressure and laboratory findings were accessed from the patient files and electronic record system in the center where the research was conducted. Since the research was conducted on HD patients, all blood pressure and dialysis data were completely available in the files. Therefore, there was no missing data in the patients included in the research. The patients' sociodemographic characteristics and parameters routinely measured and recorded before, during, and at the end of the HD session, including blood pressure and laboratory findings (serum urea, creatinine, potassium, sodium, hemoglobin, calcium, phosphorus, bicarbonate, albumin, total protein), were retrospectively obtained from patient files. The frequency of IDH was calculated based on the definition in the KDIGO guidelines (asymptomatic systolic blood pressure drop <20 mmHg).[3] Additionally, the mean systolic and diastolic blood pressure and MAP values during the HD session were obtained by dividing the entry and exit average blood pressure values by the number of HD sessions per week.

Inclusion and Exclusion Criteria

Inclusion criteria: Thirty patients over 18 years of age with end-stage renal failure who had received HD treatment for at least 6 months before and during the COVID-19 pandemic were included in the study.

Exclusion criteria: Other etiological factors that could cause IDH during HD sessions (such as sepsis, cardiac arrhythmia, embolism, bleeding, etc.) were excluded.

HD Application Procedure

High-flux HD was applied to the patients by using biocompatible HD membranes with a dialysate containing standard bicarbonate and 140 mEq/l sodium. While blood flow rates varied between 300 and 350 ml/min, the dialysate flow rate was kept constant at 500 ml/min. To calculate the given dialysis dose [urea reduction ratio (URR) and spKt/V], the post-dialysis plasma urea levels of the same dialysis session were measured by the Daugirdas method.[17]

DATA COLLECTION FORM

Age, gender, duration of dialysis (months), dry weight, pre- and post-dialysis body weight, vascular access [arteriovenous fistula (AVF) or catheter], number of sessions per week (2 or 3), dialysis adequacy markers (URR and single pool Kt/V), and laboratory data reviewed at the beginning of each month were recorded. All data were obtained retrospectively from patient files.

STATISTICAL ANALYSIS

SPSS software version 23.0 (SPSS Inc., Chicago, IL, USA) was used for statistical analysis. Descriptive statistics will be expressed as means and standard deviations for continuous variables and as counts and percentages for nominal variables. The normality of the data will be assessed using the Kolmogorov-Smirnov test. Paired t-tests and Wilcoxon tests will be used to evaluate the significance of changes between parameters before and during the COVID-19 pandemic. The relationship between IDH and other parameters will be assessed using correlation analysis. A p value <0.05 will be considered statistically significant.

RESULTS

A total of 30 patients who have been receiving CHD treatment for an average of 60,00±62,71 months (mean age: 62,60±17,79 years, 66.7% male) and of which 73.3% had AVF as their vascular access route participated in the study. All patients underwent dialysis sessions 3 days a week, lasting for 4 hours each. The patient groups that received nutrition during dialysis in the pre-COVID-19 pandemic period and those who did not receive nutrition during dialysis in the pandemic period were compared. There were no significant differences between the groups in terms of age, gender, dialysis duration, and vascular access route ($p>0.05$). The number of IDH attacks (monthly) was found to be significantly higher during the pandemic period ($p<0.05$). There was a significant difference between the number of IDH attacks in the pre- and post-pandemic period comparison in female gender and patients with AVF vascular access ($p<0.05$) (Table 1).

Table 2, provides the average systolic, diastolic blood pressure values of patients during a 1-month period. Significant differences were found between the mean systolic, diastolic blood pressure at the beginning and end of dialysis sessions ($p<0.05$).

Significant differences were also observed in the predialysis and postdialysis weight, urea, creatinine, potassium, hemoglobin, calcium, and bicarbonate values of patients during the pre-COVID-19 pandemic and the pandemic period (Table 3).

There was a positive relationship between UF value and the frequency of experiencing IDH during the COVID-19 pandemic ($p<0.05$). However, no significant relationship was found among dry weight, hemoglobin and the frequency of experiencing IDH (Table 4).

DISCUSSION

Nursing monitoring in IDH is important to prevent complications that may occur during dialysis and may lead to cessation of dialysis due to hypotension. This study aimed to determine the impact of changes in the nutrition protocol during HD sessions on the frequency of IDH during the pre-COVID-19 pandemic and the pandemic period.

TABLE 1: Distribution of IDH frequency according to sociodemographic characteristics before and during COVID-19 (n=60)

		Frequency of experiencing IDH before COVID-19 (n=30)	Frequency of experiencing IDH during the COVID-19 process (n=30)	
	n (%)	$\bar{X}$±SD Median (minimum-maximum)	$\bar{X}$±SD Median (minimum-maximum)	p^{test} value
Frequency of IDH (monthly)		3.24±2.93 3 (0-10)	4.55±3.36 4 (0-13)	0.042***
Age		62.60±17.79		
p^{test} value		0.133*	0.494*	
Gender				
Female	10 (33.3)	3.8±3.3	6.1±3.6	0.048***
Male	20 (66.7)	2.9±2.7	3.7±2.9	0.283***
p^{test} value		0.467**	0.071**	
Dialysis months		60.00±62.71		
p^{test} value		0.325*	0.737*	
Vascular access type				
AVF	24 (80.0)	3.0±3.0	4.7±3.4	0.041***
Catheter	6 (20.0)	4.0±2.7	3.8±3.2	0.414***
p^{test} value		0.487**	0.567**	

*Correlation analysis ($p<0.05$); **Independent t-test; ***Wilcoxon test. IDH: Intradialytic hypotension; COVID-19: Coronavirus disease-2019; SD: Standard deviation; AVF: Arteriovenous fistula

TABLE 2: Distribution of weekly mean systolic, diastolic blood pressure, MAP values laboratory findings of patients before and during the COVID-19 pandemic (n=60)

Variable, mmHg	Before COVID-19 (n=30)	During the COVID-19 process (n=30)	p[test]
1st week			
Pre-systolic	133.63±18.35	141.18±22.16	0.000*
Pre-diastolic	80.03±8.36	80.60±12.76	0.000*
Pre-MAP	97.90±10.55	100.79±14.79	0.000*
Post-systolic	118.70±16.01	126.01±21.44	0.000*
Post-diastolic	74.46±10.03	76.16±13.62	0.040*
Post-MAP	89.21±11.14	92.78±15.12	0.002*
2nd week			
Pre-systolic	134.00±21.52	123.04±19.74	0.001*
Pre-diastolic	82.00±9.62	73.38±12.66	0.000*
Pre-MAP	99.33±11.90	100.25±14.23	0.000*
Post-systolic	140.94±21.05	119.09±20.86	0.000*
Post-diastolic	79.90±12.33	71.58±11.48	0.000*
Post-MAP	89.94±14.28	87.42±14.14	0.000*
3rd week			
Pre-systolic	140.38±21.00	123.64±19.11	0.000*
Pre-diastolic	81.60±9.99	75.64±11.61	0.000*
Pre-MAP	101.19±12.72	99.63±11.59	0.000*
Post-systolic	141.66±20.30	123.58±18.37	0.000*
Post-diastolic	78.61±9.41	72.02±10.33	0.001*
Post-MAP	91.64±13.10	89.21±12.01	0.000*
4th week			
Pre-systolic	140.78±21.80	119.42±16.74	0.000*
Pre-diastolic	82.25±8.80	73.54±10.69	0.000*
Pre-MAP	101.76±12.62	99.75±13.34	0.000*
Post-systolic	139.31±21.40	121.01±19.76	0.000*
Post-diastolic	79.97±11.09	72.79±10.36	0.000*
Post-MAP	88.83±12.03	88.86±12.71	0.000*

*Paired Sample test
MAP: Mean arterial pressure; COVID-19: Coronavirus disease-2019; Pre-MAP: Mean arterial pressure before dialysis, Post-MAP: Mean arterial pressure after dialysis

In our study, while age and dialysis duration did not have an effect on the frequency of IDH, female patients receiving HD treatment experienced IDH more frequently than male patients during both the pre-COVID-19 pandemic and the pandemic period. Although there are studies indicating female gender as a risk factor for IDH, there are also studies suggesting that gender does not make a difference in IDH.[1,9,18] In our study, the vascular access route did not show any difference in IDH. There are also studies suggesting that the vascular access route affects the changes in blood pressure during dialysis.[19]

One of the most important findings of our study was that patients experienced a significantly higher number of IDH attacks during the COVID-19 pandemic period when they did not receive nutrition compared to the pre-pandemic period when they were nourished during dialysis. The literature contains controversial studies regarding nutrition during dialysis in relation to IDH. According to the Consensus Statement of the International Renal Nutrition and

TABLE 3: Distribution of patients according to some laboratory findings before and during the COVID-19 pandemic (n=60)

Laboratory findings			
URR	71.50±7.32	72.42±7.28	0.628*
Kt/v	1.48±0.25	1.44±0.44	0.651*
Dry weight (kg)	70.40±13.30	71.10±13.55	0.228*
Predialysis weight (kg)	72.91±13.80	73.78±14.23	0.000*
Postdialysis weight (kg)	70.61±13.43	71.23±13.72	0.000*
UF (ml)	2534.46±1054.86	2787.53±1177.67	0.130*
Pre-urea	139.70±30.92	126.13±26.70	0.000*
Post-urea	40.53±22.61	40.63±18.18	0.000*
Pre-serum creatinine	8.92±2.52	8.62±2.15	0.000*
Post-serum creatinine	3.34±1.55	3.27±1.23	0.000*
Pre-potassium	5.07±0.80	5.04±0.86	0.000*
Post-potassium	3.50±0.59	3.65±0.41	0.000*
Sodium	137.67±2.79	138.53±2.64	0.078*
Hemoglobin	11.17±1.32	11.82±1.57	0.033*
Calcium	8.72±0.67	9.08±0.66	0.010*
Phosphorus	5.23±1.39	5.09±1.60	0.635*
Bicarbonate	16.56±2.14	23.02±3.02	0.000*
Albumin	38.50±2.81	39.66±6.63	0.318*
Total protein	69.05±5.68	68.40±5.55	0.631*

*Paired Sample test. COVID-19: Coronavirus disease-2019;
URR: Urea Reduction Ratio; UF: Ultrafiltration; Kt/v: Dialysis adequacy

TABLE 4: The relationship between the frequency of experiencing IDH for some variables (n=60)

	Frequency of experiencing IDH before COVID-19 (n=30)	Frequency of experiencing IDH during the COVID-19 process (n=30)
UF (ml)	r=0.037	r=0.446
	p=0.847	p=0.015
Dry weight (kg)	r=-0.057	r=0.357
	p=0.769	p=0.057
Hemoglobin	r=-0.326	r=-0.075
	p=0.084	p=0.699

IDH: Intradialytic hypotension; COVID-19: Coronavirus disease-2019;
UF: Ultrafiltration; r: Pearson Correlation Analysis

Metabolism Society, nutrition during HD should be implemented based on individual characteristics in patients without contraindications to nutrition and who are hemodynamically stable.[11] In the study by Jelicic, it was reported that more IDH occurred when nutrition was provided during dialysis.[9] Choi, on the other hand, stated in their study that nutrition during dialysis did not affect the frequency of IDH, but rather patients showed a positive attitude towards nutrition.[13] Another study emphasized that nutrition during dialysis increased postprandial hypotension and symptomatic IDH.[20] In our study, there was a significant difference in systolic, diastolic blood pressure, and mean arterial pressure values recorded before and after dialysis for 1 month. Our study revealed that patients experienced IDH more frequently when they were not nourished during dialysis. The patients' body weight before and after dialysis was significantly higher during the COVID-19 pandemic compared to the pre-pandemic period. Additionally, there was a significant relationship between increased UF value and the frequency of IDH during the COVID-19 pandemic. This result suggests that weight gain between dialysis sessions during the COVID-19 pandemic period may have an impact on IDH.

These results imply that patients were inadequately monitored and increased their fluid intake during the pandemic period. In the study by Deng, a positive relationship between UF and IDH was found, and this relationship was reported to pose a higher risk in older and diabetic patients.[21] Increased UF leads to an increased frequency of IDH and negatively affects mortality.[22] No studies specifically focusing on IDH during the COVID-19 pandemic were found in the literature. However, Sousa reported difficulties in managing diet restrictions and a decrease in physical activity among patients during the COVID-19 pandemic.[23] The COVID-19 pandemic has negatively affected the dietary habits, physical activities, consumer behavior, sleep patterns, and emotional status of patients receiving CHD treatment. Individual monitoring of patients through telehealth methods during the pandemic period has facilitated desired changes in electrolyte levels such as potassium and phosphorus.[24] The findings of our study support the existing literature. This result emphasizes the importance of individual monitoring, especially during pandemic periods, for patients undergoing HD treatment, which significantly affects mortality. Such monitoring also influences the symptoms experienced during dialysis.

In our study, there were significant differences in laboratory findings such as serum urea, creatinine, potassium, hemoglobin, and bicarbonate values between the pre-COVID-19 pandemic and pandemic periods. The findings were within the expected range for dialysis patients. Various studies have been conducted on IDH and laboratory findings.[6,25] In Hara's study, a relationship between high hemoglobin concentration and IDH was found.[26] Different results have been observed in studies regarding the relationship between IDH and laboratory findings. Particularly during risky periods such as a pandemic, monitoring patients' laboratory findings is important considering the potential impact on the frequency of IDH.

LIMITATIONS

This study was conducted at a single center and cannot be generalized to other patients. Additionally, asymptomatic IDH was retrospectively examined in the study. It is recommended to conduct prospective studies with a larger sample size, comprehensive examination of both symptomatic and asymptomatic IDH frequencies. It also shows another limitation of the study of investigating the blood pressure, laboratory and dialysis results of patients in a period of 1 month before and after the pandemic.

CONCLUSION

The increased frequency of IDH can disrupt the dialysis process and lead to an increase in symptoms. The aim of our study was to evaluate the effect of the changing nutritional process during the COVID-19 pandemic on the frequency of IDH. One of the most important results of this study was that patients who were not fed during dialysis during the COVID-19 pandemic experienced more frequent IDH attacks. In addition to this result, it was observed that the body weight and UF amount of patients during dialysis increased during the pandemic period. Although pa-

tients underwent dialysis under hospital monitoring during this process, it is thought that the crisis process has a negative effect on patients in periods of physical, social and psychological restrictions such as the pandemic, and this effect is reflected in the dialysis process of the patients. Especially in restrictive periods such as the pandemic, patients receiving CHD treatment should be closely and individually monitored under nursing care. This monitoring should be provided not only when the patient is encountered in health institutions, but also by remote monitoring of the patients in the home environment after dialysis. Thus, it is thought that it will make positive contributions in preventing negative situations that may arise during the dialysis process and reducing the frequency of IDH.

Source of Finance

During this study, no financial or spiritual support was received neither from any pharmaceutical company that has a direct connection with the research subject, nor from a company that provides or produces medical instruments and materials which may negatively affect the evaluation process of this study.

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Yağmur Akbal Demirci, Vacide Aşık Özdemir, Ekrem Kara;* ***Design:*** *Yağmur Akbal Demirci, Vacide Aşık Özdemir;* ***Control/Supervision:*** *Yağmur Akbal Demirci, Vacide Aşık Özdemir, Ekrem Kara;* ***Data Collection and/or Processing:*** *Yağmur Akbal Demirci, Vacide Aşık Özdemir;* ***Analysis and/or Interpretation:*** *Yağmur Akbal Demirci;* ***Literature Review:*** *Yağmur Akbal Demirci, Vacide Aşık Özdemir, Ekrem Kara;* ***Writing the Article:*** *Yağmur Akbal Demirci, Vacide Aşık Özdemir, Ekrem Kara;* ***Critical Review:*** *Yağmur Akbal Demirci, Vacide Aşık Özdemir, Ekrem Kara;* ***References and Fundings:*** *Yağmur Akbal Demirci, Vacide Aşık Özdemir, Ekrem Kara.*

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