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Investigation of Oral Hygiene Habits of Individuals in the COVID-19 Pandemic Period: Cross-Sectional Study

COVID-19 Pandemi Döneminde Bireylerin Ağız Hijyeni Alışkanlıklarının İncelenmesi: Kesitsel Çalışma

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ABSTRACT Objective: It is stated that coronavirus disease-2019 (COVID-19) is mainly transmitted through cells expressing angiotensin converting enzyme 2 receptors. In our study, the relationship between oral hygiene habits and COVID-19 exposure of individuals during the COVID-19 pandemic period was studied. **Material and Methods:** After obtaining ethical approval of the study, individuals aged 20 and over who wanted to participate in the study were included. During the COVID-19 pandemic period, the questionnaire form examining the oral and dental health of the individuals was sent online between 01 and 10 January 2021. Survey form consisted of questions to measure demographic information (gender, age), status of having COVID-19, and oral hygiene habits. Analysis of the data in the study was done using the Pearson chi-square test ($p<0.05$). **Results:** A total of 1.065 people participated in our study, 62.7% (n=668) of which were female and 37.3% (n=397) were male. In our study, the frequency of tooth brushing of the individuals showed statistically significant difference according to age and gender ($p<0.05$), while the use of mouthwash did not show statistically significant difference according to age and gender ($p>0.05$). Among the individuals participating in our study, 13.8% (n=90) of those who brushed their teeth 2-3 times a day, 20.4% (n=69) of those who brushed their teeth once a day, and 21.3% (n=16) of those who brushed 2-3 times a week had COVID-19. Individuals using mouthwash (12.1%; n=57) had less COVID-19 compared to individuals who had not use mouthwash (19.1%; n=118). It was found that 33.6% (n=358) of individuals increased the frequency of tooth brushing during the COVID-19 pandemic period. **Conclusion:** In our study, it was observed that individuals who used regular tooth brushing and mouthwash during the COVID-19 pandemic had less COVID-19 disease. Therefore, it is considered that raising awareness about individual measures to protect oral and dental health will be useful in preventing COVID-19 transmission.

Keywords: COVID-19; oral hygiene; tooth brushing; mouthwash

ÖZET Amaç: Koronavirüs hastalığı-2019'un [coronavirus disease-2019 (COVID-19)], esas olarak anjiyotensin dönüştürücü enzim 2 reseptör ekspresyonu yapan hücreler üzerinden bulaştığı belirtilmektedir. Çalışmamızda COVID-19 pandemi sürecinde bireylerin oral hijyen alışkanlıkları ile COVID-19 geçirmeleri arasındaki ilişki incelendi. **Gereç ve Yöntemler:** Çalışmanın etik onayı alındıktan sonra çalışmaya katılmak isteyen 20 yaş ve üstü bireyler kabul edildi. COVID-19 pandemi döneminde bireylerin ağız ve diş sağlıklarını inceleyen anket formunu bireylere 01-10 Ocak 2021 tarihleri arasında çevrim içi olarak gönderildi. Bireylere, demografik bilgileri (cinsiyet, yaş), COVID-19 geçirme durumu ve oral hijyen alışkanlıklarını ölçmeye yönelik sorular yöneltildi. Çalışmadaki verilerin analizi, Pearson ki-kare testi ile değerlendirildi ($p<0,05$). **Bulgular:** Çalışmamıza %62,7'si (n=668) kadın ve %37,3'ü (n=397) erkek olmak üzere toplam 1.065 birey katıldı. Bireylerin diş fırçalama sıklığı yaş ve cinsiyete göre istatistiksel olarak anlamlı farklılık gösterirken ($p<0,05$), ağız gargara kullanımı yaş ve cinsiyete göre istatistiksel anlamlı farklılık göstermedi ($p>0,05$). Çalışmamıza katılan bireylerden dişlerini günde 2-3 kez fırçalayanların %13,8'i (n=90), günde 1 kez dişleri fırçalayanların %20,4'ü (n=69) ve haftada 2-3 kez fırçalayanların ise %21,3'ünün (n=16) COVID-19 geçirdiği görüldü. Ağız gargarası kullanan bireyler (%12,1; n=57), ağız gargarası kullanmayan bireylerden (%19,1; n=118) daha az COVID-19 geçirmişti. Bireylerin %33,6'sının (n=358) COVID-19 pandemi sürecinde diş fırçalama sıklığının arttığı tespit edildi. **Sonuç:** Çalışmamızda, COVID-19 pandemi dönemde düzenli diş fırçalayan ve ağız gargarası kullanan bireylerin daha az COVID-19 hastalığı geçirdiği görüldü. Bu yüzden toplumda ağız ve diş sağlığını korumaya yönelik bireysel önlemler konusunda farkındalığın artırılmasının, COVID-19 bulaşını önlemede faydalı olacağı düşünülmektedir.

Anahtar Kelimeler: COVID-19; ağız hijyeni; diş fırçalama; ağız gargarası

On December 31, 2019, it was reported that the cause of pneumonia cases of unknown etiology in Wuhan, China was a coronavirus disease-2019 (COVID-19) that had not been identified in humans before.[1] The disease caused by this virus had been identified as COVID-19 by the World Health Organization and declared as a pandemic disease.[2]

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COVID-19 is mainly transmitted by the inhalation of droplets scattered by sick individuals through speech, coughing and sneezing.[3] In addition, it has been reported that the agent is transmitted to oral, nasal and eye mucosa by hand contact with droplets contaminated surfaces.[4] Studies have identified a large number of live virus particles on the epithelial surface of the oral mucosa of a COVID-19 positive patient and on the dorsum of the tongue.[5,6]

It has been stated in the literature that cells expressing angiotensin converting enzyme 2 (ACE2) receptors should be considered as potential high risk for COVID-19 infection.[6] High ACE2 expression is observed in Type 2 alveolar cells of the lungs, multilayer epithelial cells of the esophagus, absorbent enterocytes in the colon, kidney proximal tubule cells and bladder urothelial cells in the body. It has also been shown that epithelial cells in the oral cavity (tongue, buccal mucosa, gingiva and salivary gland ducts) also express high levels of ACE2.[7] With these findings, it has been reported that the oral cavity mucosa may be a potential risk for the spread of COVID-19 infection.[4,7]

It is a well-known fact that oral health has had a major impact on overall health in recent years. It is also stated that the oral cavity is an important reservoir for respiratory pathogens, including *Chlamydia pneumoniae*, and patients with periodontal disease are more likely to develop nosocomial pneumonia.[8-10] Improving oral hygiene has been shown to reduce the risk of oropharyngeal colonization and respiratory complications, and effective oral health care has been shown to reduce the progression or occurrence of respiratory diseases, especially in the elderly population and those in intensive care units.[11]

During the COVID-19 pandemic period, individuals' oral and dental health and care habits gain importance when the stress caused by the pandemic on individuals is combined with the knowledge that dental treatments can also create a high risk of transmission. In our study, the relationship between the oral hygiene habits of individuals during the COVID-19 pandemic process and their suffering from COVID-19 disease was studied. Our null hypothesis is that individuals' oral hygiene habits will not have an impact on their transmission of COVID-19.

MATERIAL AND METHODS

Approval was obtained from the Gulhane Training and Research Hospital Clinical Research (2020/509) Ethics Committee for the study and it was conducted in accordance with the Helsinki Declaration principles.

Individuals aged 20 and over who wanted to participate in the normalization period of the COVID-19 pandemic were included in the study. Informed consent was obtained from the participants before the application of the questionnaire. A statement giving details about the purpose of the research and information that participation is optional was added to the questionnaires form. During the COVID-19 pandemic period, the questionnaire form examining the oral and dental health of the individuals was sent online between 01-10 January 2021. Survey form consisted the questions about demographic information (gender, age), having COVID-19 status, COVID-19 status of the individuals they live with, and measuring oral and dental health (Table 1).

In questions about measuring oral and dental health; whether oral and dental health is effective in preventing COVID-19 transmission, the frequency of tooth brushing, the condition of using mouthwash, what type of mouthwash is used, whether the frequency of brushing has increased during the COVID-19 period, whether they wash their hands before brushing, the frequency of changing their toothbrush, the use of toothbrush cap and keeping their toothbrush in the same place with the toothbrushes of individuals with whom they live were questioned. The questionnaire was conducted on 1,065 people in total.

STATISTICAL ANALYSIS

SPSS 22.0 Statistical program (SPSS Inc., Chicago, IL, USA) was used to evaluate the questionnaire form. The relationship between the gender and age of the individuals, having COVID-19 and the COVID-19 status of the individuals with whom they live, and the frequency of tooth brushing and mouthwash use were evaluated with the Pearson chi-square test ($p<0.05$).

RESULTS

A total of 1,065 people, 62.7% (n=668) women and 37.3% (n=397) men, participated in our study, in

which we studied the changes in the oral hygiene habits of individuals during the normalization process of the COVID-19 pandemic. The average age of the participants was 30.72±11.6 years. It was observed that 16.4% (n=175) of the individuals participating in the study had COVID-19. The people with whom 28.9% (n=308) of the individuals participating in our study lived together were infected with COVID-19.

In our study, the frequency of tooth brushing of the individuals showed a statistically significant difference according to age and gender ($p<0.05$), while the use of mouthwash did not show a statistically significant difference according to age and gender ($p>0.05$). While 68.1% of women brushed their teeth twice a day, only 49.4% of men brushed their teeth twice a day (Table 2). In addition, 42.7% of women and 40.6% of men used mouthwash (Table 2). The use of mouthwash ranged from 35.1% to 43.8% in all age groups (Table 3).

In our study, there was a statistically significant relationship between the frequency of tooth brushing and mouthwash use and having COVID-19 ($p<0.05$). It was observed that 13.8% (n=90) of individuals who brushed their teeth twice a day, 20.4% (n=69) of individuals who brushed their teeth once a day, and 21.3% (n=16) of individuals who brushed their teeth 2-3 times a week suffered from COVID-19. Individuals using mouthwash (12.1%; n=57) had less COVID-19 compared to individuals who had not used mouthwash (19.1%; n=118). From individuals

TABLE 1: Examining the oral hygiene habits of individuals during the coronavirus disease-2019 pandemic process, survey questions.

Demographic information				
Gender	Female		Male	
Age	18-30 age	31-40 age	41-50 age	+50 age
COVID-19				
Have you had a COVID-19 infectious disease?	Yes		No	
Have the individuals you live with suffered from COVID-19 infectious disease?	Yes		No	
Oral and dental health questions				
How often do you tooth brushing your teeth?	Once a day	2-3 times a day	2-3 times a week	
How often do you change your toothbrush?	1 month	3 month	6 month	
Do you use mouthwash?	Yes		No	
What type of mouthwash do you use?	Alcohol mouthwash		Alcohol-free mouthwash	
	Herbal mouthwash		No mouthwash	
Do you think the importance given to oral care is effective in preventing to be infected with COVID-19?	Yes		No	
Has your teeth brushing frequency increased with the COVID-19 pandemic?	Yes		No	
Do you wash your hands before brushing your teeth?	Yes		No	
Do you keep your toothbrush in the same place with the people you live with?	Yes		No	
Do you use a brush protective cap on your toothbrush?	Yes		No	
Did your toothbrush change frequency increase during the COVID-19 pandemic?	Yes		No	

COVID-19: Coronavirus disease-2019.

TABLE 2: Examinining the frequency of toothbrushing and mouthwash using according to gender.

Gender		Female n (%)	Male n (%)	Total n (%)	p value
Tooth brushing	Once a day	184 (27.5%)	155 (39.0%)	339 (31.8%)	
	2-3 times a day	455 (68.1%)	196 (49.4%)	651 (61.1%)	0.000
	2-3 times a week	29 (4.3%)	46 (11.6%)	75 (7.1%)	
Mouthwash using	Yes	285 (42.7%)	161 (40.6%)	446 (41.9%)	
	No	383 (57.3%)	236 (59.4%)	619 (58.1%)	0.271
	Total	668 (62.7%)	397 (37.3%)	1,065 (100%)	

who use mouthwash; 10.8% (n=10) of those who used alcoholic mouthwash, 11.6% (n=26) of those who used alcohol-free mouthwash, 16.8% (n=21) of those using herbal mouthwash and 19.1% (n=118) of those who never used mouthwash had had COVID-19 (Table 4). No statistically significant correlation was found between the frequency of tooth brushing, use of mouthwash, keeping the toothbrush in a different place, and using a toothbrush protective cap and having COVID-19 positive among the individuals living together (p>0.05), (Table 5). The individuals participating in our study (74.2%; n=790) stated that the importance given to oral care is effective in preventing COVID-19 infection (Table 6).

TABLE 3: Examining the frequency of tooth brushing and mouthwash using according to age.

Age		18-30 age n (%)	31-40 age n (%)	41-50 age n (%)	51+ age n (%)	Total n (%)	p value
Tooth brushing	Once a day	135 (22.6%)	77 (43.8%)	90 (44.6%)	37 (41.1%)	339 (31.8%)	0.000
	2-3 times a day	429 (71.9%)	86 (48.9%)	100 (49.5%)	36 (40.0%)	651 (61.1%)	
	2-3 times a week	33 (5.5%)	13 (7.4%)	12 (5.9%)	17 (18.9%)	75 (7.1%)	
Mouthwash using	Yes	260 (43.6%)	77 (43.8%)	71 (35.1%)	38 (42.2%)	339 (41.9%)	0.195
	No	337 (56.4%)	99 (56.3%)	131 (64.9%)	52 (57.8%)	651 (58.1%)	
	Total	597 (56.1%)	176 (16.5%)	202 (19.0%)	90 (8.5%)	1,065 (100%)	

TABLE 4: Examining the frequency of tooth brushing and mouthwash using according to being infected by coronavirus disease-2019.

Infected by COVID-19		Yes n (%)	No n (%)	Total n (%)	p value
Tooth brushing	Once a day	69 (20.4%)	270 (79.6%)	339 (31.8%)	
	2-3 times a day	90 (13.8%)	561 (86.2%)	651 (61.1%)	0.016
	2-3 times a week	16 (21.3%)	59 (78.7%)	75 (7.1%)	
Mouthwash using	Yes	57 (12.8%)	389 (87.2%)	446 (41.9%)	
	No	118 (19.1%)	501(79.9%)	619 (58.1%)	0.004
	Total	175 (16.4%)	890 (83.6%)	1,065 (100%)	

COVID-19: Coronavirus disease-2019.

TABLE 5: Examininingthe frequency of toothbrushing and mouthwash using according to living together individuals enfected by coronavirus disease-2019.

Living together individuals enfected by COVID-19		Yes n (%)	No n (%)	Total n (%)	p value
Tooth brushing	Once a day	105 (31.0%)	234 (69.0%)	339 (31.8%)	
	2-3 times a day	176 (27.0%)	475 (73.0%)	651 (61.1%)	0.161
	2-3 times a week	27 (36.0%)	48 (64.0%)	75 (7.1%)	
Mouthwash using	Yes	122 (27.4%)	324 (72.6%)	446 (41.9%)	0.187
	No	186 (30.0%)	419 (70.0%)	619 (58.1%)	
Keeping the toothbrush in the same place with family members	Yes	168 (28.0%)	433 (72.0%)	601 (56.4%)	0.234
	No	140 (30.2%)	324 (69.8%)	464 (43.6%)	
Using toothbrush protective cover	Yes	150 (28.5%)	377 (71.8%)	527 (49.5%)	0.398
	No	158 (29.4%)	380 (70.6%)	538 (50.5%)	
Frequecy of changing toothbrush	1 month	37 (24.7%)	113 (75.3%)	150 (14.1%)	
	3 months	167 (28.2%)	425 (71.8%)	592 (55.6%)	0.207
	6 months	104 (32.2%)	219 (67.8%)	323 (30.3%)	
Total		308 (28.9%)	757 (71.1%)	1,065 (100%)	

COVID-19: Coronavirus disease-2019.

TABLE 6: Examining the answers given by individuals to questions on oral and dental health protection during the coronavirus disease-2019 pandemic.

Oral and dental health questions	Yes n (%)	No n (%)
Do you think the importance given to oral care is effective in preventing to be infected with COVID-19?	790 (74.2%)	275 (25.8%)
Has your teeth brushing frequency increased with the COVID-19 pandemic?	358 (33.6%)	707 (66.4%)
Do you wash your hands before brushing your teeth?	854 (80.2%)	211 (19.8%)
Do you keep your toothbrush in the same place with the people you live with?	601 (56.4%)	464 (43.6%)
Do you use a brush protective cap on your toothbrush?	527 (49.5%)	538 (50.5%)
Did your toothbrush change frequency increase during the COVID-19 pandemic?	347 (32.6%)	718 (62.4%)

COVID-19: Coronavirus disease-2019.

DISCUSSION

In the COVID-19 pandemic, the number of daily cases seen in the society is still very high, as the vaccination process has just begun and the virus has mutated and started to spread faster. In this study, the relationship between oral hygiene habits and COVID-19 exposure of individuals during the normalization period of the COVID-19 pandemic was examined. In our study, our null hypothesis was rejected as individuals who brushed their teeth twice a day and used mouthwash were less likely to catch COVID-19.

As a result of insufficient oral care, the increase in the bacterial density in the mouth causes periodontal disease, tooth decay or tooth extraction. Measures to protect oral and dental health is the regular daily cleaning of plaque with tooth brushing, dental floss and mouthwash.[12] Alshehri et al. stated that the use of regular tooth brushing, flossing and mouthwash provides clinically significant benefits in reducing plaque and gingivitis.[13]

Although it is clinically stated that tooth brushing and mouthwash use is beneficial in oral hygiene, the rate of regular use in the community is low. González-Olmo et al. reported in their study on 302 COVID-19 positive patients that only 33.8% of individuals brushed their teeth twice or more every day, and 20.2% used dental floss every day.[14] In our study, it was found that 68.1% of women and 49.4% of men and total of 61.1% of the individuals brushed their teeth twice a day. In addition, 41.9% of the individuals were using mouthwash. While the frequency of brushing teeth twice a day was the highest in the 18-30 age group (71.9%), it was observed that the frequency of brushing decreased with age. The use of mouthwash ranged from 35.1% to 43.8% in all age groups.

Periodontitis, which is the most common worldwide and develops as a result of inadequate oral hygiene, is characterized by polymicrobial infection, multifactorial disease and chronic inflammation of the periodontium. If left untreated, they can lead to alveolar bone destruction and subsequent tooth loss.[15,16] It may also cause systemic complications such as pneumonia, chronic obstructive pulmonary disease, diabetes and cardiovascular diseases.[15-17] When periodontopathic bacteria are aspirated, ACE2 expression may increase in the lungs and bronchi, stimulated by periodontopathic bacterial cells and their pathogenic factors such as endotoxins. Therefore, it is stated that the increase in periodontopathic bacteria as a result of poor oral hygiene may facilitate the contract of COVID-19 by increasing ACE2 expression.[17]

Handwashing with soap or antimicrobial gels to prevent COVID-19 transmission is based on sound biological principles. In the literature, it is stated that many toothpastes contain detergents, so brushing twice a day can be effective in preventing COVID-19 transmission.[18] It is also stated that by using antiseptic mouthwashes, the risk of transmission can be prevented by reducing the oral viral load of COVID-19.[19]

In our study, it was observed that as the frequency of tooth brushing increased, individuals caught COVID-19 less. It was observed that 13.8% of individuals who brushed their teeth twice a day, 20.4% of individuals who brushed their teeth once a day, and 21.3% of individuals who brushed their teeth

2-3 times a week suffered from COVID-19. Individuals using mouthwash (12.1%) had fewer COVID-19 infection than individuals who did not use mouthwash (19.1%). These results suggest that individuals who brush their teeth twice a day and use mouthwash have better oral health and may have less COVID-19 because of a decrease in viral load in the mouth.

It is stated that antimicrobial mouthwashes, which are effective on dental bacterial plaque in the mouth, are effective on COVID-19 virus density in the mouth.[20-22] Meiller et al. stated in their clinical studies on oral antiseptic mouthwashes (Listerine, Johnson & Johnson, ABD) to reduce the viral load in saliva during active viral infection that there was a decrease in viral contamination in the oral fluids for at least 30 minutes after using mouthwash.[23] Yoon et al. stated that after using 15 mL of 0.12% chlorhexidine gluconate, severe acute respiratory syndrome-coronavirus-2 was suppressed for two hours and this suppression would be beneficial for the control of COVID-19 transmissions.[24] Kampf et al. found that CoVs were effectively inactivated with 62-71% ethanol, 0.5% hydrogen peroxide or 0.1% sodium hypochlorite, but they stated that biocidal agents such as 0.05-0.2% benzalkonium chloride or 0.02% chlorhexidine gluconate were less effective.[25]

In our study, individuals who used alcohol (10.8%) and non-alcoholic (11.6%) mouthwash had a lower rate of COVID-19 than individuals who did not use mouthwash (19.1%). The rates of catching COVID-19 were comparable for those who used herbal mouthwash (16.8%) and those who did not (19.1%). These results show that the daily use of alcoholic and non-alcoholic mouthwash to protect oral and dental health is effective in preventing COVID-19 disease.

It is stated that COVID-19 is transmitted by sneezing and coughing, respiratory secretions, droplets, direct body contact and surface contact.[26] Small virus of this caliber has a higher potential for aerosols to breathe deep into the lungs, suggesting that it could potentially cause infection in the alveolar tissues of the lower respiratory tract.[27] It has been reported in the literature that sterilizing materials used for oral hygiene (toothbrush, toothpaste, etc.) and keeping them separately after use may be beneficial in preventing the transmission of COVID-19 among individuals living together.[14] No statistically significant correlation was found between the frequency of tooth brushing, use of mouthwash, keeping the toothbrush in a different place, and using a toothbrush protective cap and having COVID-19 positive among the individuals living together ($p>0.05$). This situation is considered to be due to the individuals living together in close contact and they contact with the virus more frequently.

Hygiene practices, including hand washing, to slow the spread of COVID-19 are the first line of defense to reduce infection transmission. The level of knowledge of individuals about COVID-19 is important to adopt behavioral changes in COVID-19 protection. Keleş et al. stated in their studies on oral and dental health during the COVID-19 pandemic process that 20.6% of the participants brushed their teeth more frequently and 28.7% of them stated that the use of mouthwash increased.[28] 74.2% of the individuals participating in our study stated that the importance given to oral care was effective in preventing infection with COVID-19, and 33.6% stated that their frequency of brushing teeth increased during the COVID-19 pandemic.

Our study was conducted during the period when dental services were interrupted due to the COVID-19 pandemic. Although there is evidence that the emphasis on oral and dental health is important for preventing COVID-19 colonization and the transmission of infection, more research is needed to demonstrate how poor hygiene can contribute to the burden of infection and cross-contamination.

CONCLUSION

It was observed that there were positive trends in the habits of individuals to protect oral and dental health during the quarantine and controlled social life process applied after the onset of the COVID-19 epidemic. Individuals stated that they brush their teeth more thinking that the importance given to oral and dental health was effective in preventing COVID-19 transmission. In our study, it was observed that indi-

viduals who regularly (2-3 times a day) brush their teeth and use mouthwash during the COVID-19 pandemic period caught less COVID-19. In addition, alcoholic and non-alcoholic mouthwashes used to protect oral and dental health are more effective in preventing COVID-19 disease. Therefore, it is considered that during the COVID-19 pandemic period, increasing the awareness of individuals about oral and dental health protective measures will be beneficial in reducing the risk of COVID-19 transmission.

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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: *Numan Aydın, Serpil Karaoğlanoğlu, Elif Aybala Oktay, Bilge Ersöz;* ***Design:*** *Numan Aydın, Bilge Ersöz;* ***Control/Supervision:*** *Numan Aydın, Serpil Karaoğlanoğlu;* ***Data Collection and/or Processing:*** *Numan Aydın, Bilge Ersöz;* ***Analysis and/or Interpretation:*** *Numan Aydın, Serpil Karaoğlanoğlu, Bilge Ersöz;* ***Literature Review:*** *Numan Aydın, Bilge Ersöz;* ***Writing the Article:*** *Numan Aydın, Serpil Karaoğlanoğlu, Elif Aybala Oktay;* ***Critical Review:*** *Serpil Karaoğlanoğlu, Elif Aybala Oktay;* ***References and Fundings:*** *Numan Aydın;* ***Materials:*** *Numan Aydın.*

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