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RESEARCH ARTICLE

The effectiveness of telemedicine methods in the follow-up of asthma in the COVID-19 pandemic process

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ABSTRACT

The effectiveness of telemedicine methods in the follow-up of asthma in the COVID-19 pandemic process

Introduction: Telemedicine is a health service that provides diagnosis, treatment evaluation, preventive medicine by using information and communication technologies between distant locations and aims to improve the health of the individuals and society. Social restrictions were applied during the pandemic process caused by coronavirus disease-2019 due to the virus called severe acute respiratory syndrome coronavirus-2 which emerged in late 2019. Through remote communication and information technologies in the follow-up of asthma patients, there is a need for studies on the effectiveness of using telemedicine methods was seen.

Materials and Methods: Our study included 328 patients aged 18 to 65 who were diagnosed with asthma and followed up by our team. The clinical evaluations and scale results of these patients were conducted at least three times by a single physician using telemedicine applications. In our study, the control group consisted of routine control results from asthma patients, who were reachable via hospital records before the pandemic, covering a one-year period. This file review includes data from October 1, 2019, to October 1, 2020.

Results: Three hundred and twenty-eight patients with asthma were included in the study. When the current data of the participants were compared with face-to-face data before follow-up with telemedicine, no statistically significant difference was found ($p > 0.05$). Although there was a slight decrease in asthma control test scores during the follow-up, it was not statistically significant ($p > 0.05$). A statistically significant difference was found in severe persistent asthma as a result of the comparison of the asthma control test results of the participants in follow-up according to disease severity ($p < 0.05$). In this study, when the effect of the presence of comorbidity on asthma control test results in follow-up was examined, statistically significant results were obtained ($p < 0.05$).

Conclusion: It is predicted that telemedicine will have an important place in disease control since asthma is a disease that requires close monitoring.

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Disease follow-up with telemedicine was predicted to be a good alternative to traditional face-to-face follow-ups in selected patient groups. This study also supported the effectiveness of telemedicine.

Key words: Asthma; telemedicine; asthma control

ÖZ

COVID-19 pandemisi sürecinde astım takibinde teletıp hizmetlerinin etkinliği

Giriş: Teletıp, günümüz teknolojilerini kullanarak uzak mekanlar arasında bilgi ve iletişimi sağlayan, tanı, tedavi değerlendirmesi ve önleyici hekimlik gibi sağlık hizmetlerini sunan bir yöntemdir. 2019'un sonlarında ortaya çıkan şiddetli akut solunum yolu sendromu koronavirus-2 (SARS-CoV-2) adlı virüse bağlı olarak koronavirus hastalığı-2019 (COVID-19) pandemisi yaşanmıştır. Pandemi sürecinde, sosyal kısıtlamalar getirilmiş ve hastalarımızın hastane başvurularını azaltarak, COVID-19 maruziyeti riskinin yüksek olduğu hastanelere gitmelerinin azaltılması hedeflenmiştir. Uzaktan iletişim kanallarının kullanılmasıyla hasta-hekim işbirliği artırılmış, hastaların hastaneye başvurmak zorunda kalmadan da etkin bir şekilde hastalık kontrolünün sağlanması amaçlanmıştır.

Materyal ve Metod: Çalışmamıza, 18-65 yaş arasında astım tanısı kesinleşmiş ve tarafımızca takip edilen 328 hasta dahil edilmiştir. Bu hastaların klinik değerlendirmeleri ve ölçek sonuçları, teletıp uygulamalarıyla en az üç kez, tek bir hekim tarafından yapılmıştır. Çalışmamızda kontrol grubu olarak, pandemi öncesinde hastane kayıtları üzerinden ulaşılabilen, astım tanısı almış hastalarımızın bir yıl içindeki rutin kontrol sonuçları kullanılmıştır. Bu dosya taraması, 01.10.2019 ile 01.10.2020 tarihleri arasındaki verileri kapsamaktadır.

Bulgular: Katılımcıların teletıp ile takip öncesi yüz yüze alınan verileriyle karşılaştırıldığında, istatistiksel olarak belirgin bir fark saptanmamıştır ($p > 0.05$). Takiplerde, astım kontrol testi (AKT) puanlarında hafif bir azalma gözlemlense de, bu fark istatistiksel olarak anlamlı bulunmamıştır ($p > 0.05$). Katılımcıların takiplerindeki AKT sonuçları, hastalık şiddetine göre karşılaştırıldığında, ağır persistan astımlı hastalarda istatistiksel olarak anlamlı bir fark saptanmıştır ($p < 0.05$). Ayrıca, ek hastalık varlığının takiplerdeki AKT sonuçları üzerindeki etkisi incelendiğinde, bu fark istatistiksel olarak anlamlı bulunmuştur ($p < 0.05$).

Sonuç: Astım takiplerinin teletıp yöntemleriyle yapılmasının ardından elde edilen verilerde istatistiksel olarak anlamlı bir farklılık gözlemlenmemesi, teletıp yöntemlerinin yüz yüze görüşmelere alternatif olabileceğini göstermektedir. Astım kontrol test puanlarının zamanla azalma eğiliminde olması, tamamen teletıp ile sürdürülecek takiplerin gerekliliği açısından önemlidir. Özellikle ağır persistan astımlı hastaların takibinde, yalnızca semptom takibi ve hasta beyanına dayalı anketlerin yeterli olmadığı anlaşılmaktadır. Komorbid hastalıkların astım kontrolünü olumsuz etkilediği görülmüştür. Bu nedenle, her görüşmede komorbiditelerin de değerlendirilmesi, tedavi düzenlemeleri ve gerekirse telekonsültasyonla multidisipliner bir yaklaşım önerilmektedir. Sonuç olarak, astım hastalığı sıkı takip gerektiren bir hastalık olduğundan, teletıpın hastalık kontrolünde önemli bir yer tutacağı öngörülmektedir. Teletıp, seçilmiş hasta grubunda geleneksel yüz yüze takiplere iyi bir alternatif olma potansiyeline sahiptir ve çalışmamız bu durumu desteklemektedir.

Anahtar kelimeler: Astım; teletıp; astım kontrolü

INTRODUCTION

Asthma is a heterogeneous disease characterized by chronic airway inflammation which is associated with airway hypersensitivity to direct or indirect stimuli. It is defined by limited expiratory airflow and respiratory symptoms such as shortness of breath, chest tightness and cough (1). Social restrictions were imposed during the coronavirus disease-2019 (COVID-19) pandemic process, which was caused by the virus named severe acute respiratory syndrome coronavirus-2, which emerged at the end of 2019. Especially those with chronic diseases could not go to hospitals in this process and their follow-up became a problem. Recently, telemedicine methods have started to be used in the follow-up of asthma patients through remote communication and information technologies.

Telemedicine is a type of health service that aims to improve the health of the individuals and society for diagnosis, treatment evaluation and preventive

medicine purposes by using information and communication between places far from each other. It was defined as the practice of remote medicine in which interventions, diagnoses, treatment decisions and recommendations are based on patient data, documents and other information transmitted via telecommunication systems at the 60th and 69th General Meetings of the World Medical Association (WMA) (2). With the development of information technologies, researchers have begun using telemedicine methods in the follow-up of chronic diseases. In a study by Portnoy et al., it has been shown that telemedicine methods could be a good alternative to traditional face-to-face meetings in the follow-up of asthma (3). In a meta-analysis study of 22 studies by Chongmelaxme et al., it has been shown that telemedicine methods are effective in quality of life and asthma control in asthmatic patients (4).

In a study conducted by Malipiero et al. during the COVID-19 period, it was shown that telemedicine



services might have a place in the treatment and follow-up of patients followed up in allergy clinics (5). In this study, the place of telemedicine methods was investigated in patients diagnosed with asthma and followed up by us during the COVID-19 pandemic period. Social isolation was essential to prevent the spread of COVID-19 during the pandemic period. Primary objectives of our study were determined as the effectiveness of telemedicine methods in the follow-up of patients with asthma, awareness of patients about asthma treatment steps, ensuring their active participation in treatment decisions, and reducing the risks of COVID-19 exposure with remote follow-ups. Secondary goals were determined as the comparison of asthma control test (ACT) scores obtained in follow-up with telemedicine methods with the scores obtained in follow-up with traditional face-to-face methods, the change of drugs used in treatment selection with the active participation of patients, the effects of telemedicine methods on ACT scores in the presence of asthma severity and comorbidities.

With the use of remote communication channels, it is aimed to increase patient-physician cooperation and to provide effective control of the disease without the patient's application to the hospital.

MATERIALS and METHODS

Patients diagnosed with asthma aged 18 to 65 were included in this study. It was planned to use ACT for asthma control of these patients. Asthma control and treatment of our participants was planned to be arranged individually. Initial interviews were conducted face-to-face at the pulmonology outpatient clinic. Sociodemographic data, asthma treatments, asthma severity, smoking status, comorbidities, and occupation were questioned at the first interview.

Prospective clinical evaluation of the cases participating in the study and the evaluation of the scales were performed by a physician at least three times with telemedicine applications. Telephone calls and video calls over the internet were used as telemedicine applications. Social isolation and lockdown during the pandemic caused patients, especially those with chronic respiratory diseases, to avoid hospitals as much as possible. This resulted in patients not attending traditional outpatient follow-up appointments. For this reason, no control group could be recruited during the pandemic period to come to the chest diseases outpatient clinic controls to be evaluated face-to-face at the first, third and

sixth months. This can be stated as the reason for the weakness in our study. In order to reduce the weakness due to the lack of a control group in our study, participants' pre-pandemic data and ACT results were included in the comparison with telemedicine data.

Hospital records of our asthmatic patients who participated in this study and followed up by us were used before the pandemic period. These records include complaints, findings, medications for asthma, history, family history, and ACT results in the last one year. File scanning covers the dates between 01.10.2019 and 01.10.2020. It was aimed to compare the hospital data of the patients one year prior to the pandemic, at the beginning, and during the first month, third month and sixth month of the pandemic. In this way, we aimed to compare the effectiveness of traditional outpatient clinic examinations and telemedicine applications in asthma control.

With the decision taken by the Ministry of Health in our country during the pandemic period, it was ensured that drugs were purchased from pharmacies without a prescription in order to reduce the hospital admissions of the patients.

Approval was obtained from our hospital Health Sciences Ethics Committee for the study (No: 20.478.486).

Study Group and Procedure

Patients are currently being followed up in our clinic, and it was noted that there had been a positive reversibility test or bronchial provocation test before. Participants were included in our study after obtaining their consent form confirming that they had been informed about the study. The criteria for inclusion in the study were determined as no recent asthma exacerbation, regular use of medications, and regular doctor follow-up. Attention was paid to the fact that the participants were asthmatic patients who were followed up regularly in our clinic for at least one year. Treatments of the patients were arranged according to the ACT results. As the ACT was affected during the routine outpatient application, those who did have asthma exacerbation in the meantime as result of clinical examination and evaluation were not included in the study. Participants who were hospitalized and admitted to the emergency department due to comorbidities during the follow-ups were excluded from the study because they could impair asthma

control and give similar symptoms. Patients who lacked the ability to evaluate the truth and had a disability to complete the clinical interview and self-assessment scales in a healthy way were not included in the study. Patients who did not accept or could not use telemedicine applications were not included in this study. Telephone calls and video calls over the internet were used as telemedicine applications. The telemedicine method to be used was left to participant preference. All participants preferred phone calls to video conferencing. After telemedicine preference, the same telemedicine method was used in each clinical interview with the participants. Clinical evaluation of the patients participating in the study and evaluation of the scales were performed by the same pulmonologist.

Participants were scheduled for online doctor appointments with their preferred telemedicine method at one, three and six months. The participants were asked the following questions and ACT as standard at each interview:

- During the past four weeks, how often did your asthma prevent you from getting as much done at work, school or home?
- During the past four weeks, how often have you had shortness of breath?
- During the past four weeks, how often did your asthma symptoms (wheezing, coughing, chest tightness, shortness of breath) wake you up at night or earlier than usual in the morning?
- During the past four weeks, how often have you used your reliever inhaler (usually blue one in Türkiye)?
- How would you rate your asthma control during the past four weeks?
- What medications have you been using for asthma for the last one month?
- Are you using your asthma medications regularly every day?
- Have you applied to the emergency department for asthma since our last meeting?
- Have you had hospitalization or admitted to the emergency department due to your comorbidities since our last meeting?

At the last interview, patients were questioned about the number of exacerbations, the number of hospi-

talizations and emergency service admissions due to asthma. At the end of each interview, the asthma treatments of the participants were arranged according to the GINA asthma step treatment recommendations.

Sociodemographic Data Form

Patients were questioned in the sociodemographic and clinical information form about age, sex, financial status, level of education, profession, presence of a diagnosis of illness in their own and family history, smoking history, asthma duration, family history of asthma, and the presence of medications used.

Asthma Control Test

It is a test with five questions and scores between one and five in each question. The scores related to the answer to each question are written to the evaluation. The sum of the five points constitutes the total score. ACT score of 20 or above suggests that asthma is under control (6). Turkish validity and reliability study of the test to be used was performed by Uysal et al (7).

Statistical Analysis

Data obtained in the study were evaluated statistically with the program "SPSS Statistics 21". As descriptive statistics, frequency, percentage values, median (interval between quarters), mean and standard deviation values were determined. For comparisons, Student's t-test was used for numerical variables that fit the normal distribution, and Mann Whitney U test was used for numerical variables that did not fit the normal distribution. Comparisons between categorical variables were made with the chi-square test. Comparative correlation analyses (Pearson, Spearman) were used to determine the variables affecting asthma control, and $p < 0.05$ was considered statistically significant in statistical analyses.

RESULTS

Seven hundred and forty-nine asthma patients were contacted for inclusion in this study. Of those, 132 did not agree to participate. Two hundred and forty-one participants were excluded from the study because they were included in the exclusion criteria and less than three interviews were made during the follow-up process with telemedicine methods. Twenty-eight participants were excluded from the study due to the unreliability of the data for various reasons. As a result, the study was completed with 328 people who met the criteria. It is shown in the consort diagram table in more detail (Figure 1).

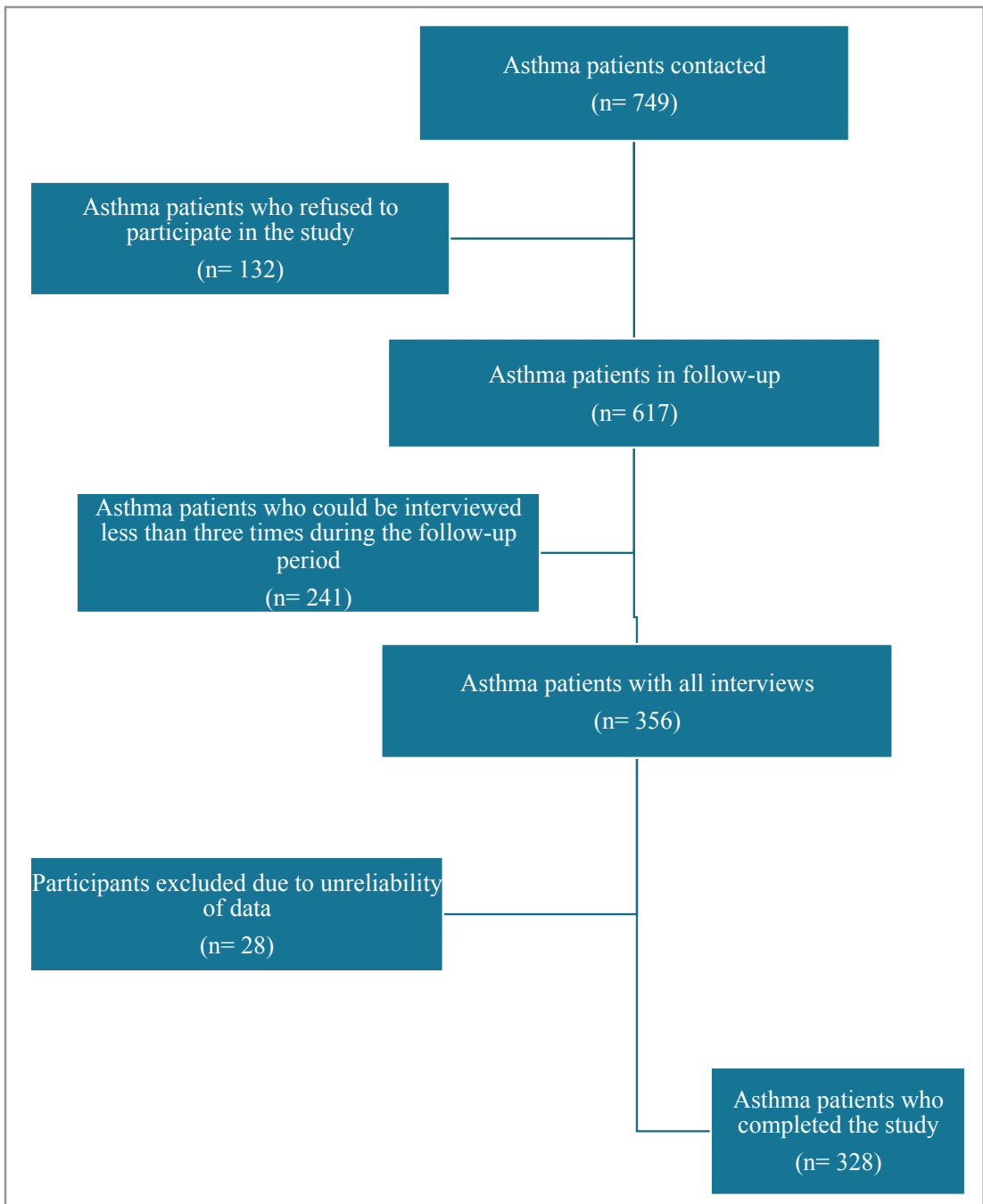


Figure 1. Consort flow diagram.

The sample number of the study who were diagnosed with asthma and accepted to participate in the study by meeting the inclusion criteria was 328. When we look at the socially descriptive findings of the participants, it is seen that 31.7% of them are civil servants and 29.6% of them are housewives in terms of profession and they constitute the majority. Although

82.1% of the participants have never smoked, 1.2% are active smokers. 75.9% of the patients have additional diseases other than asthma. When the treatments used by the participants for asthma were examined, it was seen that 97.8% used SABA, 92.6% used ICS, and 87.8% used LABA+IKS. Table 1 shows the socially descriptive findings, clinical features and

Table 1. Distribution of sociodemographic characteristics, clinical features and asthma medications used

Variables	Mean $\pm$ SD	Minimum and Maximum
Age (years)	38.4 $\pm$ 9.7	20-65
Height (cm)	169.2 $\pm$ 6.4	148-188
Weight (kg)	62.1 $\pm$ 4.9	42-130
Body mass index (kg/m ²)	25.7 $\pm$ 4.1	15.3-44.9
Disease duration (years)	8.2 $\pm$ 4.5	2-36
Variables	n (%)	
Sex		
Male	78 (23.8)	
Female	250 (76.2)	
Profession		
Worker	28 (8.5)	
Officer	104 (31.7)	
Housewife	97 (29.6)	
Retired	19 (5.8)	
Farmer	21 (6.4)	
Student	33 (10.1)	
Self-employment	22 (6.7)	
Other	4 (1.2)	
Education		
Uneducated	19 (5.8)	
Primary school	61 (18.6)	
Middle school	66 (20.1)	
High school	114 (34.7)	
University	68 (20.8)	
Smoking status		
Never smoked	269 (82.1)	
Exsmoked	55 (10.7)	
Smoker	4 (1.2)	
Disease stage		
Mild intermittent	41 (12.5)	
Mild persistent	92 (28.1)	
Moderate persistent	116 (35.3)	
Severe persistent	79 (24.1)	
Comorbidities (75.9%) (n= 249)		
Allergic rhinitis	156 (32.9)	
Urticaria	27 (5.6)	
Hypertension	51 (10.7)	
Diabetes mellitus	47 (10.3)	
Coronary artery disease	49 (9.9)	
Atopic dermatitis	13 (2.7)	
Gastroesophageal reflux	72 (15.1)	

Table 1. Distribution of sociodemographic characteristics, clinical features and asthma medications used (continue)		
Variables	Mean $\pm$ SD	Minimum and Maximum
Connective tissue diseases	21 (4.4)	
Other	38 (8)	
Treatments ¹		
SABA	321 (97.8)	
LABA	98 (29.8)	
ICS	304 (92.6)	
Tiotropium	69 (21)	
Combined therapy (LABA+ICS)	288 (87.8)	
Theophylline	29 (8.8)	
LTRA	247 (75.3)	
Nebulizer	102 (31)	
LTOT	31 (9.4)	
Biological agents	73 (22.2)	
SD: Standard deviation.		
¹ SABA: Short-acting β_2 agonist, LABA: Long acting β_2 agonist, ICS: Inhaled corticosteroids, LTRA: Leukotriene receptor antagonists, LTOT: Long term oxygen therapy.		

medications of the patients in detail. As a result of the six-month follow-up of the participants with remote telemedicine methods, ACT, number of asthma attacks, hospitalizations due to asthma and emergency service admissions were examined in terms of assessing asthma control. When the current data of the participants were compared with the telemedicine and pre-follow-up data, no statistically significant difference was found ($p > 0.05$).

While the mean ACT scores were 16.9 ± 5.7 at the beginning, it was 16.3 ± 5.9 at the third month and 15.7 ± 6.3 at the sixth month. Although there was a slight decrease in ACT scores in the follow-ups, it was not statistically significant ($p > 0.05$).

While the number of asthma attacks was 1.4 ± 0.8 before telemedicine, it was not statistically significant as 1.3 ± 0.8 after six months of follow-up ($p > 0.05$).

Detailed data on the ACT values and the number of asthma attacks in the follow-up of the patients are presented in Table 2.

As a result of the comparison of the ACT results of the participants in the follow-up according to the severity of the disease, no statistically significant difference was found in the groups other than severe persistent asthma ($p > 0.05$). In severe persistent asthma patients, statistical significance was observed in the sixth month data. Comparison of ACT values according to disease severity in follow-ups is presented in Table 3.

Previously, it was stated that 75.9% of the participants had additional diseases. In this study, statistically significant results were obtained when the effect of the presence of additional disease on the ACT results in the follow-ups was examined ($p < 0.05$). At the end of the sixth month of follow-up, mean ACT scores were 16.1 ± 5.0 and 14 ± 7.6 , respectively, in the absence or presence of additional disease. This situation was found to be statistically significant ($p < 0.05$). The effects of the presence of additional disease on the ACT results are presented in Table 4 in detail.

Table 2. ACT values and number of asthma attacks in the follow-up of the patients						
Parameters	Pre-study	Baseline	1 st month	3 rd month	6 th month	p
ACT	16.7 ± 6.5	16.9 ± 5.7	16.4 ± 6.0	16.3 ± 5.9	15.7 ± 6.3	0.19
Number of asthma attacks	1.4 ± 0.8				1.3 ± 0.8	0.30
Number of hospitalizations	1.1 ± 0.4				1.2 ± 0.4	0.29
Emergency service applications	1.3 ± 0.7				1.2 ± 0.9	0.33
ACT: Asthma control test.						

Table 3. ACT results according to disease severity

	Mild intermittent	Mild persistent	Moderate persistent	Severe persistent
Baseline	22.9 ± 2.2	19.6 ± 3.5	16.7 ± 5.1	13.8 ± 7.2
1 st month	22.8 ± 2.2	19.6 ± 3.4	16.4 ± 5.0	13.7 ± 6.9
3 rd month	22.8 ± 2.1	19.3 ± 3.0	16.1 ± 5.3	13.5 ± 6.1
6 th month	22.5 ± 2.0	19.1 ± 3.6	15.8 ± 5.8	12.1 ± 8.9
p	p= 0.40	p= 0.28	p= 0.31	p= 0.04

ACT: Asthma control test.

Table 4. ACT results by presence of comorbidities

	No comorbidities (n= 79)	Comorbidities (n= 249)	p
Baseline	16.9 ± 6.0	16.8 ± 5.8	p= 0.40
1 st month	16.5 ± 5.6	16.3 ± 6.9	p= 0.36
3 rd month	16.5 ± 6.1	15.8 ± 5.7	p= 0.08
6 th month	16.1 ± 5.0	14.0 ± 7.6	p= 0.045
p	p= 0.11	p= 0.039	

ACT: Asthma control test.

Table 5. Rates of asthma treatment received by participants before and after the study

	Pre-study	Post-study
	n (%)	n (%)
SABA	321 (97.8)	301 (91.8)
LABA	98 (29.8)	14 (4.3)
ICS	304 (92.6)	107 (32.6)
Tiotropium	69 (21)	72 (21.9)
ICS+LABA (combined therapy)	288 (87.8)	297 (90.5)
Theophylline	29 (8.8)	3 (0.9)
LTRA	247 (75.3)	215 (65.5)
Nebulizer	102 (31)	7 (2.1)
LTOT	31 (9.4)	31 (9.4)
Biological agent	73 (22.2)	73 (22.2)

SABA: Short-acting β_2 agonist, LABA: Long acting β_2 agonist, ICS: Inhaled corticosteroids, LTRA: Leukotriene receptor antagonists, LTOT: Long term oxygen therapy.

At the beginning of the study, the treatments the participants received for asthma were examined. As can be seen in Table 5, it was observed that some patients received treatments such as LABA, ICS and theophylline in addition to the combined treatment for asthma. As a result of the six-month follow-up of asthma with telemedicine methods by the same physician, some arrangements were made in the treatment of patients. It was observed that the use of LABA decreased to 4.3%, the use of theophylline to 0.9%, and the use of nebulizers to 2.1%. At the end of the

study, the treatment rates of the participants due to asthma are shown in detail in Table 5.

DISCUSSION

In this study, we showed that asthma follow-up does not reduce asthma control for up to six months when done with telemedicine methods. Telemedicine methods may be a good alternative to traditional face-to-face interviews in selected patient groups. Telemedicine methods can be a good alternative to traditional face-to-face consultations in selected patient groups.

In the long-term follow-up of asthma patients, the physician should evaluate the response to the treatment given at each interview. As a result of the evaluation of the treatment response, the control status of asthma should be determined and the treatment should be rearranged. However, these follow-ups are not always provided under optimal conditions and in standardized periods. Access to the right to health is interrupted in every period due to major socioeconomic differences. However, this situation has come to light due to the COVID-19 pandemic, which started in late 2019. In terms of the continuation of the sustainability of health services, solutions have begun to be sought globally.

In this period, the use of telemedicine methods aimed at providing health services increased by the use of information and communication technologies between distant places. Telemedicine is expected to be a good adjunct. However, it is not expected to completely replace traditional face-to-face patient-physician consultations. The average age of asthma patients participating in our study is approximately 38.4, and it is seen that they were in the ideal age range in terms of adaptation to information and communication technologies. Mean body mass index is 25.7, and we considered that we could exclude obesity-related respiratory symptoms. When we examined the distribution by sex, it is seen that the female/male ratio is 3.1 and there are more female participants. It is compatible with the higher prevalence of asthma in women in adulthood (8). In addition, age and sex distribution was similar to the multicenter Phenoturk study conducted by Yıldız et al. for asthma phenotypes in Türkiye (9).

When we looked at the literature, we saw that telemedicine methods has gained importance especially recently. In a study by Doshi et al., 14 different studies were examined and it was seen that multimedia training was the most used telemedicine method in terms of asthma. Positive results were seen in 12 of the 14 studies (10). On the other hand, we primarily investigated whether telemedicine methods could be an alternative to face-to-face patient-physician interviews not patient education.

In another study, Harada et al. examined the effect of a guiding smartphone application on asthma control for asthma patients in a Japanese population. It was observed that the smartphone application alone provides weak asthma control. It was stated that physician consultations were needed for the control of

asthma and other additional diseases. It was shown that asthma control would increase with repeated use of the application (11). In this study, we planned and implemented one-on-one meetings with telemedicine in terms of patient-physician trust and treatment compliance. Similarly, it has been shown that face-to-face or telemedicine consultation services are needed to assess comorbidities. In the study of Cingi et al., in which asthma patients could reach their physicians via mobile phones, patients with ACT >19 at three-month follow-up were found to be statistically significant compared to the control group (12). These results also showed parallelism with our study.

In this study, the ACT results of our patients at the first, third and sixth months did not show a statistically significant difference compared to those of the baseline and pre-study. Obtaining similar results at one, three and six months follow-up shows that telemedicine methods can be used in the follow-up and treatment of asthma patients. Although it is not statistically significant, it is seen that the ACT score averages tend to decrease as the follow-up period increases. This was important as it predicted that follow-ups should not be continued entirely with telemedicine. There are time and method differences in the retrospective data of the participants on asthma. In addition, there are no standardized questions in these interviews. This is the weakness of this study. Retrospective and prospective data yielded similar results, despite differences in data provision. This suggests that telemedicine methods may have a place in the future in the follow-up of asthma patients. In a study by Portnoy et al., it has been shown that telemedicine follow-up of asthma can be a good alternative to traditional face-to-face meetings (3). In the large-scale meta-analysis study of Chongmelaxme et al., telemedicine methods have been shown to be effective in disease control in the follow-up of asthma patients (4). In addition, the success of asthma control with telemedicine was demonstrated in a study conducted in a region where access to healthcare services was limited during the COVID-19 pandemic period (13). The studies in the literature showed parallelism with our results. Another result of this study was the effects of six-month telemedicine follow-ups on the number of asthma attacks, the number of hospitalizations, and emergency department admissions. It was observed that the six-month follow-up with telemedicine did not yield statistically significant results with the pre-study data. In this respect, it was seen that telemedicine applications could be an

alternative to face-to-face interviews. In one of their studies, Mammen et al. followed up asthmatic patients aged 18-44 years with telemedicine methods. As a result of the study, it was seen that asthma control with telemedicine was statistically significantly better (14). In addition, the use of rescue drugs and emergency service applications decreased. It was observed that drug and treatment compliance and the rates of receiving asthma treatment at appropriate levels increased. A study by Cvietusa et al. also showed that telemedicine methods resulted in fewer exacerbations and steroid use (15). These results also support this study. When we examined the results of the asthma control test according to the severity of the disease, it was seen that the disease control of mild intermittent and mild persistent asthma was better. Although the ACT scores of moderate persistent asthmatics decreased as the follow-up period increased, it was not statistically significant. However, it was not possible to be optimistic when it came to severe persistent asthma. In the follow-ups, ACT scores gradually decreased, which was statistically significant. As the follow-up period got longer, asthma control became more difficult. A study conducted by Hall et al. has shown that participant rates decrease as time increases in telemedicine follow-ups. It has been observed that follow-up rates with telemedicine decrease over time, especially in patients with severe asthma and patients with comorbidities (16). This may be because asthma control becomes more difficult as time increases. There were a randomized controlled study of Hashimoto et al. on the subject regarding the follow-up of steroid-dependent severe asthma patients with internet-based telemedicine method. In this study, symptom monitoring, pulmonary function test and exhaled nitric oxide (FeNO) measurement were performed at home for six months. With the telemedicine method, oral corticosteroid doses were reduced, and asthma control, FEV₁, hospitalization and the number of attacks were found to be similar between the two groups (17). These results differed from our study. The reason for this may be that in our study, asthma patients were followed up with symptoms and ACT, whereas in that study, patients were observed with household devices with quantitative data. This seems to be one of the weaknesses of our study. Especially when the follow-up of severe persistent asthma with telemedicine methods was planned, symptom follow-up and questionnaires based on patient declaration were not sufficient alone.

Considering that the lack of follow-up of comorbidities made asthma control difficult, it was expected that asthma control with telemedicine would also be more difficult. When we examined the effect of comorbidities on asthma control, it was seen that they impaired asthma control in a statistically significant way. This has especially become evident with the prolonged follow-up period. The importance of evaluating additional comorbidities, which have an important place in the evaluation of asthma, becomes evident here. A study has shown that telemedicine follow-up rates decreases as time period increases in asthmatics with comorbidities (16). Another study showed that older asthmatics with comorbidities did not want to participate in telemedicine methods (15). With these results, a different method should be conducted to follow up asthmatic patients with comorbidities using telemedicine methods. In this case, the use of teleconsultation can be offered as a recommendation. In our study, we have to accept the lack of follow-up and treatment of additional patients as a weakness. Many misused medications were detected at the beginning regarding the treatment of asthmatic patients who participated in this study. As a result of telemedicine follow-up of the participants for six months by a single physician, many changes were made in asthma treatments. As a result of these changes, the rate of LABA+IKS combined treatment increased. The use of additional inhaled corticosteroids, long-acting β_2 agonists and theophylline reduced. In addition, it was observed that the use of short-acting β_2 agonists as rescuers and the need for nebulizer inhaler decreased. It is thought-provoking that the ACT scores, the number of asthma attacks, the number of hospitalizations and emergency department admissions did not change in a statistically significant way although the use of drugs decreased. This phenomenon might have been due to the fact that patient follow-ups were carried out by different physicians at the beginning, the patients accumulated drugs because they did not remember the treatments they had taken, and that they were confused with other obstructive pulmonary diseases such as asthma and COPD.

In addition, one of the reasons for excessive drug use may be that patients could buy drugs from pharmacies without a prescription during the pandemic period in Türkiye. This situation can lead to wrong, incomplete and excessive treatment practices and even abuses. In addition, as stated in the GINA Asthma Diagnosis and Treatment guidelines, the use of methylxanthine-derived drugs such as theophyl-

line was not recommended in the treatment of asthmatic patients (1). The decrease in theophylline used from 8.8% at the beginning to 0.9% at the end of the study can be interpreted as overuse of the patients. This problem could be solved by written treatment and follow-ups, the education of the patients and the physicians, and the greater participation of the patients in the treatments. Today, we hope that these problems will be solved in time thanks to the ease of access to information with telemedicine methods.

In our study, 24.1% of the participants had severe persistent asthma. We found a statistically significant deterioration in asthma control in patients with severe persistent asthma during follow-up with telemedicine. In the literature, there are different results in the follow-up of patients with severe asthma with telemedicine. Pelaez et al. have observed no difference between telemedicine methods and face-to-face follow-up of patients with severe asthma (18). In the study by Hall et al. the dropout rate of patients with severe asthma from telemedicine follow-up was found to be higher (16). Following these patients for shorter periods of time or shortening the follow-up period with telemedicine may increase asthma control rates. In addition, home SFT, PEFmeter or FeNO devices can be used to better monitor asthma at home. However, the difficulty of implementing this method in terms of price/performance is controversial. One of the points to be considered in terms of asthma follow-up with telemedicine is patient selection. The diagnosis of asthma should be confirmed by the attending physician, and the patient's asthma and inhaler education level should be known by the physician who will follow up. There are studies that show that even an action plan alone is ineffective in patients who have a written action plan prepared and who did not receive adequate asthma education (19,20). For such reasons, it would be appropriate to not use telemedicine methods in the follow-up of patients whose patient-doctor trust has not yet been established, newly diagnosed, or whose asthma treatment has just been arranged.

CONCLUSION

With the developing technology, it is expected that telemedicine methods will become widespread and will appear in every moment of life. There are many studies in the literature regarding the effectiveness of telemedicine methods. Our study gives similar results with the literature. It is still of great importance to

determine ethical problems, compliance with medical deontology, standardized follow-up and algorithms. These problems can be solved through local professional associations, as suggested by the WMA (2). It is seen that telemedicine applications will fill our agenda more in the near future.

As a result, it is predicted that telemedicine will have an important place in disease control since asthma is a disease that requires close follow-up. Disease follow-up with telemedicine is predicted to be a good alternative to conventional face-to-face follow-ups in selected patient groups.

Limitations of Study

This study has some limitations. The inability to form a control group due to social isolation and closures, especially during the pandemic period, can be shown as the main limitation and weakness. Studies comparing balanced and similar patient groups with telemedicine follow-up and face-to-face outpatient clinic follow-up should be planned. With new studies, the suitability of telemedicine methods can be evaluated under more optimum conditions. Physical examination could not be performed because the participants were evaluated by telephone. This is one of the important limitations of our study. We tried to reduce the weakness of the study with standardized questions and questionnaires. However, the use of more quantitative data such as PEF variability will increase the power of telemedicine studies.

Another limitation is that telemedicine methods have not yet been standardized. Methods and conditions vary from country to country and region to region. There is a need for standardized telemedicine methods by forming working groups. In our study, standardized methods that we created ourselves were applied.

Patients' comorbidities may affect asthma control. The inability to provide medical consultation with telemedicine for the evaluation of comorbidities can be considered another limitation.

Ethical Committee Approval: This study was approved by Manisa Celal Bayar University Faculty of Medicine Health Sciences Ethics Committee (Date: 02.09.2020, Decision no: 20.478.486).

CONFLICT of INTEREST

The authors declare that they have no conflict of interest.

AUTHORSHIP CONTRIBUTIONS

Concept/Design: ŞMŞ, YH

Analys/Interpretation: YH, DK

Data acquisition: ŞMŞ

Writing: ŞMŞ

Clinical Revision: DK

Final Approval: YH

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