The effects of the COVID-19 pandemic on the case profile of the Pathology Department of a tertiary hospital: Comparison of the number of cases and malignancy rates between 2019 and 2020

COVID-19 pandemisinin üçüncü basamak bir hastanenin Patoloji Bölümü vaka profiline etkileri: 2019-2020 yılları arasındaki vaka sayısı ve malignite oranlarının karşılaştırılması

Gulsum Seyma Yalcin, Cigdem Ozdemir, Cigdem Tokyol

Department of Pathology, Afyonkarahisar University of Health Sciences, Faculty of Medicine, Afyonkarahisar, Turkey

ABSTRACT

Introduction: Because of the COVID-19 (coronavirus disease-2019) pandemic the number of applications to health institutions for non-COVID-19 reasons has generally decreased for many reasons. We aimed to investigate the case volume of 2019 and 2020 with the rates of malignant and non-malignant categories to document the effects of the pandemic to a pathology department of a tertiary hospital.

Methods: All the pathology reports that routinely examined in 2019 and 2020 in the department of pathology of a tertiary hospital in Turkey were evaluated from the hospital records. For the purpose of exact comparison, cases interpreted as before and after the first COVID-19 case in Turkey (March 11, 2020) (pre-covid and post-covid period). All the cases divided into diagnostic categories as malignant and non-malignant. We also evaluated biopsies and cytologies both together and also separately.

Results: A total of 23325 pathology reports were evaluated (14105 cases in 2019, and 9220 cases in 2020). Comparing with the same period of previous year, in post-covid period of 2020 there was 43.6% reduction in all cases, 41.3% reduction in biopsies, and 47.4% reduction in cytology cases. The malignancy rate of the post-covid period of 2020 cases was higher than that of 2019 (13.1% vs 10.6%, respectively, p<0.001). The month with the most significant decrease in case volume by 84.9% and also highest malignancy rate with 25.7% was April 2020. In both malignant and non-malignant categories, mean age of the 2020 cases were lower than that of 2019 cases (p= 0.018 and p<0.001, respectively). In both years the malignancy rates were significantly higher in women.

Conclusion: In the post-COVID period, we experienced the decrease in our pathology and cytology case volume as all over the world, but with a significant increase in the malignancy rates.

Key words: COVID-19, Pandemic, Pathology, Cytology, Case volume

ÖZET

Giriş: COVID-19 (Koronavirüs hastalığı-2019) pandemisi nedeniyle sağlık kuruluşlarına COVID-19 dışı nedenlerle yapılan başvuruların sayısı genel olarak birçok nedenden dolayı azalmıştır. Pandeminin üçüncü basamak bir hastanenin patoloji bölümüne etkilerini belgelemek için 2019 ve 2020 vaka sayılarının, malign ve malign olmayan kategori oranlarıyla birlikte araştırılması amaçlanmıştır.

Yöntemler: Türkiye'de üçüncü basamak bir hastanenin patoloji bölümünde 2019 ve 2020 yıllarında rutin olarak incelenen tüm patoloji raporları hastane kayıtlarından değerlendirildi. Karşılaştırma amacıyla, vakalar Türkiye'deki ilk COVID-19 vakasının (11 Mart 2020) öncesi ve sonrası (COVID öncesi ve sonrası dönem) olarak ele alındı. Tüm olgular malign ve malign olmayan olarak tanı kategorilerine ayrıldı. Ayrıca biyopsiler ve sitolojiler hem birlikte, hem de ayrı ayrı değerlendirildi.

Bulgular: Toplam 23325 patoloji raporu (2019'da 14105, 2020'de 9220 vaka) değerlendirildi. Bir önceki yılın aynı dönemine göre 2020 yılı COVID sonrası dönemde tüm vakalarda %43,6, biyopsilerde %41,3 ve sitoloji vakalarında %47,4 azalma tespit edildi. 2020 vakalarının COVID sonrası dönemdeki malignite oranı 2019'dakinden daha yüksekti (sırasıyla %13,1 ve %10,6, p<0,001). Vaka hacminde %84,9 ile en belirgin düşüşün ve aynı zamanda %25,7 ile en yüksek malignite oranının olduğu ay Nisan 2020 oldu. Hem malign hem de malign olmayan kategorilerde 2020 vakalarının yaş ortalaması 2019 vakalarına göre daha düşüktü (p=0,018 ve p<0,001, sırasıyla). Her iki yılda da kadınlarda malignite oranları anlamlı derecede yüksekti.

Sonuç: Tüm dünyada olduğu gibi bizim bölümümüzde de COVID-19 pandemisi sonrasındaki dönemde patoloji ve sitoloji vaka hacmimizde azalma; ancak malignite oranlarında önemli artışlarla tespit edilmiştir.

Anahtar Kelimeler: COVID-19, Pandemi, Patoloji, Sitoloji, Vaka sayısı

Corresponding author: Gulsum Seyma Yalcin, Department of Pathology, Afyonkarahisar University of Health Sciences, Faculty of Medicine, Afyonkarahisar, Turkey
E-mail: drgsu@hotmail.com
Eskisehir Med. J. 2022; 3(2):226-233.
Received date:09.02.2022 Accepted date:20.06.2022
Authors: Gulsum Seyma Yalcin (ORCID: 0000-0002-1944-2955), Cigdem Ozdemir (ORCID: 0000-0001-8500-0744), Cigdem Tokyol (ORCID: 0000-0001-5971-5295)

INTRODUCTION

First cases of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) were reported on December 2019 from Wuhan, China. The disease caused by SARS-CoV-2 was named as the coronavirus disease-2019 (COVID-19). The first COVID-19 case in Turkey was detected on March 11th, 2020 (1). At similar times COVID-19 became pandemic that affects too many people all over the World. For the purpose to prevent the spread of disease, various restrictive measures were applied in Turkey, as well as in all countries. Some different ways of lockdowns were implemented, especially for people with chronic illness, <18 and >65 years of age (2). Schools closed and online education started. People were warned to stay at home and follow social distancing rules (3).

During the COVID-19 pandemic, the operations of elective cases in healthcare facilities had to be interrupted from time to time. In addition, people felt uneasy about going to routine control examinations because the fear of the possibility of COVID-19 infection (4). For these reasons, number of applications to health institutions for non-COVID-19 reasons has generally decreased (3-7). For example one emergency department from Turkey reported approximately 50% reduction in applications in the pandemic period (8). In another study 25% reduction was found in the number of surgical patient visits to the emergency department during first three months of the COVID-19 outbreak (3). In one multicenter study from Turkey, 75% reduction was observed in the total number of urological surgeries in the first three months of the pandemic (9). It was reported that a significant decrease was also observed in cardiological emergencies too (10). Along with these data, the lockdown because of the COVID-19 pandemic had a significant impact on hospital admissions for cancer diagnosis and treatment (11). Therefore, it can be estimated that the number of cases examined in the pathology department has decreased too. There are some reports showing the effects of pandemic to the case numbers of pathology departments in the literature (12-14), but very few reports demonstrated the differences in malignancy rates of the pathology and cytology case volume (4, 15, 16). Herein we aimed to compare the number of cases reported in our Pathology Department in 2019 and 2020 with the rates of malignant and non-malignant categories to document the effects of the pandemic to a pathology department of a tertiary hospital if there is a decrease in the number of cases and increase the malignancy rates due to pandemic.

METHODS

In this single-center, retrospective cross-sectional study, all the pathology reports that routinely examined in 2019 and 2020 in the department of pathology of a tertiary hospital in Turkey were evaluated from the hospital records. The demographic datas of the patients and pathologic details of the cases were recorded from the pathology reports. According to the contents of the pathology reports, all the cases divided into diagnostic categories as malignant and non-malignant. If there is an exact malignant diagnosis in the pathology report, we put them in the malignant category. But if there is an entity in the borderline category or uncertainty about the diagnosis, we take these cases in the non-malignant category with non-malignant cases. We also evaluated biopsies and cytologies both together and also seperately.

For the purpose of exact comparison, both evaluated years' cases interpreted as before and after the first COVID-19 case in Turkey. So we compare cases before March 11th, 2020 with cases before March 11th, 2019 (for convenience we will call this time period as pre-covid period in the rest of the article). And also we compare cases from March 11th to 31st December in 2020 with cases from March 11th to 31st December in 2019 (for convenience we will call this time period as

Table 1. Demographic and clinicopathologic data of all cases in 2019 and 2020

		2019	2020	Total	p
Gender, n (%)	Women	9609 (68.1)	6238 (67.7)	15847 (67.9)	<0.001
	Men	4496 (31.9)	2982 (32.3)	7478 (32.1)	
Sample type, n (%)	Biopsy	8934 (63.3)	6130 (66.5)	15064 (64.6)	
	Cytology	5171 (36.7)	3090 (33.5)	8261 (35.4)	
Diagnosis, n (%)	Malignant	1474 (10.5)	1170 (12.7)	2644 (11.3)	
	Non-malignant	12631 (89.5)	8050 (87.3)	20681 (88.7)	
Age, years, mean±SD (median (min-max))		48.9±19 (49 (1-100))	46.8±19 (47 (1-93))	48.1 ±19 (48 (1-100))	<0.001
Total, n (%)		14105 (60.5)	9220 (39.5)	23325 (100)	<0.001

SD: standard deviation

post-covid period in the rest of the article), with age, gender, malignancy rates, biopsy and cytology case numbers.

Ethical approval was obtained from Afyonkarahisar University of Health Sciences Clinical Research Ethics Committee (2021/218).

Statistical analysis

Statistical analyzes were performed using Statistical Package for Social Sciences version 20 software (IBM SPSS). The compatibility of the data with normal distribution was examined with the Kolmogorov-Smirnov test. The qualitative datas were shown in the tables as number (n) and frequency (%), and quantitative datas as mean (mean) ± SD and median with minimum and maximum values. The chi-squared and Mann–Whitney U tests were used for non-parametric variables. In all evaluations, the p values <0.05 were considered statistically significant.

RESULTS

The study included 23325 pathology reports (14105 pathology reports in 2019, and 9220 pathology reports in 2020). When compared to 2019, total number of all cases in 2020 decreased by 34.6%. The characteristics of patients for each year are demonstrated in Table 1.

In order to compare more accurately, we evaluate cases before and after March 11th 2020, the first Covid-19 case seen in Turkey (we named these two time periods as pre-covid and post-covid period). We match the cases of 2020 with corresponding time period of the previous year. There was 2926 and 2912 cases in pre-covid period in 2019 and 2020, respectively, which were almost same. There was 11179 and 6308 cases in the post-covid period in 2019 and 2020, respectively. Comparing with the same period of previous year, in post-covid period of 2020 there was 43.6% reduction in all cases, 41.3% reduction in biopsies and 47.4% reduction in cytology cases. The numbers and

malignancy rates of all cases and also seperately biopsies and cytologies in the post-covid period in 2019 and 2020 are shown in Table 2. The malignancy rate of the post-covid period of 2020 cases was statistically higher than that of 2019 (13.1% vs 10.6%, respectively, p<0.001).

Table 2. The numbers and malignancy rates of all cases and also seperately biopsies and cytologies from March 11 to December 31 in 2019 and 2020

		Malignant	Non-malignant	Total	p
2019, n (%)	Biopsy	1126 (15.9)	5959 (84.1)	7085 (100)	<0.001
	Cytology	58 (1.4)	4036 (98.6)	4094 (100)	
2020, n (%)	Biopsy	793 (19.1)	3363 (80.9)	4156 (100)	
	Cytology	34 (1.6)	2118 (98.4)	2152 (100)	
2019, n (%)		1184 (10.6)	9995 (89.4)	11179 (100)	<0.001
2020, n (%)		827 (13.1)	5481 (86.9)	6308 (100)	

Most of the cytology specimens are cervicovaginal smear samples of the women. When comparing malignancy rates between men and women, cervicovaginal smear samples for screening purpose reduce the malignancy rates. For this reason we evaluate only biopsy malignancy rates between men and women. In both years the malignancy rates were significantly higher in women. Besides, both sexes had higher rates of malignancy in 2020 than in 2019. The malignancy rates of biopsies according to gender in the post-covid period of 2019 and 2020 are shown in Table 3.

Mean age of the malignant cases were 64 and 61, in 2019 and 2020, respectively. Mean age of the non-malignant cases were 47 and 44, in 2019 and 2020, respectively. In both groups mean age of the cases in 2020 were lower than that of cases in 2019 (p= 0.018 and p<0.001, malignant and non-malignant categories, respectively). The ages of malignant and non-malignant cases in 2019 and 2020 after March 11th to December 31st are shown in Table 4.

Table 3. The malignancy rates of only biopsies according to gender after March 11th to December 31st in 2019 and 2020

		Malignant	Non-malignant	Total	p
2019, n (%)	Women	499 (11.9)	3688 (88.1)	4187 (100)	<0.001
	Men	627 (21.6)	2271 (78.4)	2898 (100)	
2020, n (%)	Women	369 (15.1)	2079 (84.9)	2448 (100)	
	Men	424 (24.8)	1284 (75.2)	1708 (100)	

When all the months in 2019 and 2020 are compared separately, the total number of cases, biopsy and cytology numbers are shown in the Table 5. And also these changes are demonstrated in Figure 1. The month with the most significant decrease in the number of cases was April 2020 (84.9% reduction).

The malignancy rates by month is shown in Table 6. The month with the highest malignancy rate was April 2020 with 25.7%, and the second was May 2020 with 16.7%. One of four cases were malignant in April 2020.

Table 4. The ages of malignant and non-malignant cases in 2019 and 2020 after March 11 to December 31.

Age, years	Malignant		Non-malignant	
	Mean±SD	Median (min-max)	Mean±SD	Median
2019	64±14	65 (5-93)	47±19	47 (1-100)
2020	61±16	64 (2-93)	44±19	43 (1-91)

SD: Standard Deviation

Table 5. All case numbers and also seperately biopsy and cytology case numbers of all months in 2019 and 2020

		Biopsy			Cytology			Total		
		2019	2020	Change%	2019	2020	Change%	2019	2020	Change%
Months	January	821	873	6.3↑	447	395	11.6↓	1268	1268	-
	February	777	803	3.3↑	451	387	14.2↓	1228	1190	3.1↓
	March	742	561	24.4↓	498	249	50↓	1240	810	34.7↓
	April	761	157	79.4↓	508	34	93.3↓	1269	191	84.9↓
	May	781	176	77.5↓	394	82	79.2↓	1175	258	78↓
	June	586	508	13.3↓	305	294	3.6↓	891	802	10↓
	July	714	542	24.1↓	467	281	39.9↓	1181	823	30.3↓
	August	570	472	17.2↓	322	260	19.3↓	892	732	17.9↓
	September	770	471	61.2↓	455	247	45.7↓	1225	718	41.4↓
	October	731	531	27.4↓	399	303	24.1↓	1130	834	26.2↓
	November	807	447	55.4↓	449	272	39.4↓	1256	719	42.8↓
	December	874	589	32.6↓	476	286	40↓	1350	875	35.2↓
Total		8934	6130	31.4↓	5171	3090	40.2↓	14105	9220	34.6↓

DISCUSSION

As COVID-19 has become a serious health problem since December 2019, it has also had negative effects in many areas of life. The number of applications to health institutions for non-COVID-19 reasons has generally decreased (3-7). It is inevitable that pathology departments will also be affected due to the decrease in hospital admissions. In one study from United States 13% decrease was reported in surgical pathology specimens compared with pre-pandemic period (12). But other studies showed more decline in the volume of cases. Compared to the pre-pandemic period, 79-85.6% reduction rates in pathology specimens have been reported in the post-COVID period in different studies (4, 13, 14). In the current study, we found 43.6% reduction in all cases of our pathology department in 2020 after March 11 (post-covid period), the first COVID-19 case was seen in Turkey, to the end of the year, when comparing with the same period of the previous year. The reduction rates of our cases of March and April 2020 were 84.9% and 78%. These findings were almost similar with other studies in the literature (4, 13, 14).

In one study from United States 5% decrease in cytology specimens compared with pre-pandemic period (12). But other studies showed more decrease in the volume of cytology cases. Compared to the pre-pandemic period, different reduction rates of cytology cases have been reported in different studies:, 45.3% (16), 85% (4), 88.7% (13) and 92.6% (15). The cytology cases in this study in the post-covid period in 2020 were lower by 47.4% than corresponding period of 2019. The reduction rates of our cytology cases of March and April 2020 were 93.3% and 79.2%. These findings were almost similar with other studies in the literature (4, 13, 15, 16).

In this study the ratio of women/men of all the cases was almost more than 2 in 2019; and this didn't change in 2020. It is known that in practice most of the cytology specimens are cervicovaginal smear samples of the women. Therefore, cytology samples were excluded when comparing women/men malignancy rates. For accurate assessment, when comparing only biopsies

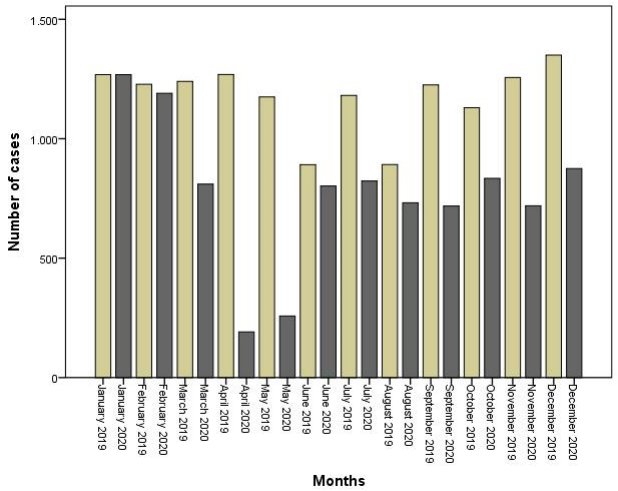

Figure 1. Changes in the number of cases by month in 2019 and 2020.

Table 6. The malignancy rates by month in 2019 and 2020

		2019		2020	
		Non-malignant	Malignant	Non-malignant	Malignant
Months, n (%)	January	1142 (90.1)	126 (9.9)	1118 (88.2)	150 (11.8)
	February	1103 (89.8)	125 (10.2)	1047 (88.0)	143 (12.0)
	March	1123 (90.6)	117 (9.4)	706 (87.2)	104 (12.8)
	April	1141 (89.9)	128 (10.1)	143 (74.9)	48 (25.1)
	May	1035 (88.1)	140 (11.9)	215 (83.3)	43 (16.7)
	June	779 (87.4)	112 (12.6)	701 (87.4)	101 (12.6)
	July	1055 (89.3)	126 (10.7)	725 (88.1)	98 (11.9)
	August	794 (89.0)	98 (11.0)	644 (88.0)	88 (12.0)
	September	1097 (89.6)	128 (10.4)	619 (86.2)	99 (13.8)
	October	1003 (88.8)	127 (11.2)	735 (88.1)	99 (11.9)
	November	1126 (89.6)	130 (10.4)	628 (87.3)	91 (12.7)
	December	1233 (91.3)	117 (8.7)	769 (87.9)	106 (12.1)
Total		12631 (89.5)	1474 (10.5)	8050 (87.3)	1170 (12.7)

according to gender, malignancy rates were much higher in women in 2019 (11.9% vs 21.6%, women and men, respectively). This rates were both increase in 2020 (15.1% vs 24.8% women and men, respectively). In our opinion this difference may be due to the fact that women are more likely to apply to the hospital for control and screening purposes and men may be admitted to the hospital when their symptoms are more severe.

In the current study the mean age of both malignant and non-malignant cases in the post-pandemic period of 2020 was lower than the mean age of cases of the same period of 2019 (p= 0.018 and p<0.001, malignant and non-malignant categories, respectively). This finding is compatible with literature data (11), and shows that elderly patients were more hesitant to apply to the hospital probably because of their personal health risk. It may also have been effective in this case that the restrictions were imposed more strictly on the older group.

Despite the decrease in the number of cases, significant increases in the malignancy rates of biopsy and cytology specimens have been reported in many studies. Ahmad et al. reported that the rate of cancer cases increased from 22% to 35% (4). In an international cytopathology article, the malignancy rate of non-gynecological samples were increased by 5.56% (16). Rana et al reported 34.1% increase in the malignancy rates of cytology specimens from India during lockdown for approximately 2 months (15). There was a significant increase in the overall malignancy rate in the post-covid period of 2020 compared with same period of 2019 in this study (13.1% vs 10.6, respectively; p<0.001). When biopsies and cytologies are evaluated separately, the malignancy rate of biopsies significantly increased from 15.9% to 19.1% (p<0.001) and the malignancy rate of cytology samples increased from 1.4% to 1.6% (p=0.611). These findings show that people avoided applying to the hospital due to the pandemic and only went to hospital when the necessary situation is serious. In addition, these findings suggest that in the long term, cancer cases may be detected at later stages. Studies covering longer time periods will better show the long-term effects of the pandemic.

We evaluate all the pathology and cytology cases in 2019 and 2020. But for the correct assesssment, we

compare the cases after March 11, 2020, when the first COVID-19 case was seen in Turkey, to the end of the year with the same period of 2019. This comparison encompasses almost 10 months long data. The most significant decrease in the number of cases was seen in April 2020, when the restrictions were more intense. In April 2020, there was a decrease by 79.4% in biopsy numbers, 93.3% in cytology numbers and 84.9% in all cases. In the summer and autumn of 2020 (June to September), the restrictions were not implemented due to the decrease in the number of COVID-19 cases in Turkey. However the decrease in the number of pathology cases continued in these months. Actually, the number of cases in June 2020 and August 2020 was close to June 2019 and August 2019, respectively. But the number of cases were less in June and August 2019 compared to other months in 2019, due to the prolongation of the holiday period of the Ramadan Feast and Feast of the Sacrifice because coinciding with the weekdays. Therefore, we think that the number of cases between June 2020 and June 2019, and August 2020 and August 2019 is close for this reason. In November and December 2020, the decrease in the number of cases was again as high as 42.8%, probably due to the increase in COVID cases during these months.

CONCLUSION

The COVID-19 pandemic dramatically impacted health systems, and pathology departments were also effected. From March 11 2020, when the first seen COVID-19 case in Turkey, to the end of the year, we experienced the decrease in our pathology and cytology case volume as all over the world, with a significant increase in the malignancy rates. Also the mean age of the patients in 2020 after the first COVID-19 case in Turkey was lower than the mean age of the cases of the corresponding period of the previous year. This shows the elderly patients were more affected. These findings suggest that in the long term, cancer cases may be detected at later stages. The data in this study can be considered limited as it is a single center study. We think multi-center studies covering longer time periods will better show the long-term effects of the pandemic.

Conflict of Interest: The authors have no conflicts of interest to declare.

Financial Disclosure: The authors declare that this study has received no financial support.

REFERENCES

1. Çiftçiler R, Haznedaroğlu İ C, Tufan A, Öztürk MA. Covid-19 scientific publications from Turkey. Turk J Med Sci. 2021;51(3):877-889.
2. Şık N, Duman M, Yılmaz D, et al. Evaluation of COVID-19 Disease and the Effect of Trends in Intervention Measures: The Pediatric Perspective from a Tertiary Care Hospital in Turkey. Balkan Med J. 2021;38(4):222-8.
3. Göksoy B, Akça MT, Inanç Ö F. The impacts of the COVID-19 outbreak on emergency department visits of surgical patients. Ulus Travma Acil Cerrahi Derg. 2020;26(5):685-92.
4. Ahmad Z, Rahim S, Ud Din N, Ahmed A. Practice of Academic Surgical Pathology During the COVID-19 Pandemic. Am J Clin Pathol. 2020;154(6):724-30.
5. Hartnett KP, Kite-Powell A, DeVies J, et al. Impact of the COVID-19 Pandemic on Emergency Department Visits - United States, January 1, 2019-May 30, 2020. MMWR Morb Mortal Wkly Rep. 2020;69(23):699-704.
6. Ojetti V, Covino M, Brigida M, et al. Non-COVID Diseases during the Pandemic: Where Have All Other Emergencies Gone? Medicina (Kaunas). 2020;56(10).
7. Pellegrini M, Roda M, Lupardi E, Di Geronimo N, Giannaccare G, Schiavi C. The impact of COVID-19 pandemic on ophthalmological emergency department visits. Acta Ophthalmol. 2020;98(8):e1058-e9.
8. Çıkrıkçı Işık G, Çevik Y. Impact of COVID-19 pandemic on visits of an urban emergency department. Am J Emerg Med. 2021;42:78-82.
9. Çakıcı M, Temiz MZ, İplikçi A, et al. The clinical impact of the COVID-19 pandemic on daily urological practice: first 3-month multicenter results from İstanbul. Turk J Med Sci. 2021;51(3):962-71.

10. Toniolo M, Negri F, Antonutti M, Masè M, Facchin D. Unpredictable Fall of Severe Emergent Cardiovascular Diseases Hospital Admissions During the COVID-19 Pandemic: Experience of a Single Large Center in Northern Italy. J Am Heart Assoc. 2020;9(13):e017122.
11. Reichardt P, Bollmann A, Hohenstein S, et al. Decreased Incidence of Oncology Admissions in 75 Helios Hospitals in Germany during the COVID-19 Pandemic. Oncol Res Treat. 2021;44(3):71-5.
12. Sinard JH. An Analysis of the Effect of the COVID-19 Pandemic on Case Volumes in an Academic Subspecialty-Based Anatomic Pathology Practice. Acad Pathol. 2020;7:2374289520959788.
13. Brandler TC, Warfield D, Adler E, et al. Lessons Learned From an Anatomic Pathology Department in a Large Academic Medical Center at the Epicenter of COVID-19. Acad Pathol. 2021;8:2374289521994248.
14. Miller TI, Smith KD, Gonzalez-Cuyar LF, Swanson PE. Operational Impacts of the Coronavirus Disease 2019 (COVID-19) Pandemic and Early Recovery Trends: University of Washington Anatomic Pathology Experience. Arch Pathol Lab Med. 2021;145(4):399-406.
15. Rana C, Kumar S, Babu S, et al. Impact of ongoing COVID-19 pandemic on cytology: An institutional experience. Diagn Cytopathol. 2021;49(2):311-5.
16. Vigliar E, Cepurnaite R, Alcaraz-Mateos E, et al. Global impact of the COVID-19 pandemic on cytopathology practice: Results from an international survey of laboratories in 23 countries. Cancer Cytopathol. 2020;128(12):885-94.

Cite as: Yalcin GS, Ozdemir C, Tokyol C. The effects of the COVID-19 pandemic on the case profile of the Pathology Department of a tertiary hospital: Comparison of the number of cases and malignancy rates between 2019 and 2020. Eskisehir Med J. 2022;3(2):226-233.