



# Effect of the COVID-19 Pandemic on Emergency Department Presentations with Mushroom Poisoning: A Report from Turkey

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## Abstract

**Background** In this study, we investigated the effect of the coronavirus disease 2019 (COVID-19) pandemic on emergency department admissions with mushroom poisoning in a tertiary hospital in Turkey.

**Materials and Methods** This study was conducted as a retrospective cohort study to evaluate the data of patients admitted to the emergency department between January 1, 2018, and December 31, 2020. The patients diagnosed with the International Classification of Diseases-10 code T62.0 concerning the toxic effect of ingested mushrooms were identified through the computerized medical and laboratory record system of the hospital. The patients' demographic data, presentation seasons, laboratory findings, emergency department outcomes, and mortality due to mushroom poisoning were obtained. To reveal the effect of COVID-19 pandemic on emergency department presentations with mushroom poisoning, the means of the pre-pandemic period (2018–2019) and the pandemic period (2020) were compared.

**Results** The data of a total of 171 patients were included in the final analysis. The number of patients diagnosed with the toxic effect of ingested mushrooms was 96 in 2018, 61 in 2019, and 14 in 2020. There was a 5.6-fold decrease during pandemic period in the number of patients presenting to the emergency department with mushroom poisoning.

**Conclusion** The decrease in mushroom poisoning cases may be related to the changes in the eating habits of individuals during the pandemic and our study being conducted in a metropolitan city. We recommend that multicenter studies be performed to verify the data obtained from our study and increase their generalizability.

## Keywords

- ▶ mushroom poisoning
- ▶ poisoning
- ▶ coronavirus disease 2019
- ▶ toxic

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## Introduction

More than 5,000 mushroom species have been classified in the world, and more than 100 species have been found to be poisonous. Among these species, ~10 are known to cause fatal poisoning.<sup>1</sup> Poisonous mushrooms contain different toxins that can cause different clinical manifestations. It has been reported that ~2.5 to 7% of all poisoning cases in the world are due to the mushroom ingestion. This rate has been reported as 0.5 to 3% in studies conducted in Turkey. In the last decade, the number of mushroom poisoning cases has decreased due to the increase in the production of cultivated mushrooms, production of various species in the culture environment, and increased public awareness.<sup>2</sup>

The World Health Organization (WHO) declared coronavirus disease 2019 (COVID-19) as a pandemic on March 11, 2020, and the first case was seen in Turkey on the same day.<sup>3</sup> Since then, measures taken by governments and individuals have affected the behavioral characteristics of societies. In the peak periods of the disease, the hospital admissions of all non-COVID-19 elective cases were postponed.<sup>4-6</sup> However, there was no significant increase in the number of non-COVID-19 emergency department admissions across the world.<sup>7</sup> In a study from China, Li et al reported an increase in mushroom poisoning cases in 2020.<sup>8</sup> Similarly, in a study from Israel, Lurie et al reported an increased number of mushroom poisoning cases compared with the fall/winter period in 2019 and noted an increase in the median annual rate between 2015 and 2019.<sup>9</sup> In light of this literature, we aimed to investigate the effect of the COVID-19 pandemic on emergency department presentations with mushroom poisoning in a tertiary hospital in Turkey.

## Materials and Methods

### Study Design

This study was conducted as a retrospective cohort study at Umraniye Training and Research Hospital, University of Health Sciences, a 795-bed tertiary education hospital with 1,110 daily emergency department presentations (annual average of the study period). The data of patients who presented to the emergency department between January 1, 2018, and December 31, 2020, were retrospectively collected. To reveal the effect of COVID-19 pandemic on emergency department presentations with mushroom poisoning, the means of the pre-pandemic period (2018–2019) and the pandemic period (2020) were compared.

### Study Population

The population of the study consisted of adult patients who presented to the emergency department with symptoms of mushroom poisoning during the study period. The patients who were diagnosed with the International Classification of Diseases (ICD)-10 code T62.0 of the WHO medical classification concerning the toxic effect of ingested mushrooms were identified through the computerized medical and laboratory record system of the hospital. Patients with missing data were excluded from the study. The flowchart of the study is shown in **Fig. 1**.

## Data Collection

The patients' demographic data, presentation seasons, laboratory findings, emergency department outcomes, and mortality due to mushroom poisoning were obtained from the computer-based hospital system. The patient's files with the ICD-10 code T62.0 toxic effect of ingested mushrooms were obtained from the hospital computer-based data system in the electronic environment. Data were organized by the researchers (S.Ö. and İ.A.). The presentation season of the patients was recorded as winter (December, January, and February), autumn (September, October, and November), spring (March, April, and May), and summer (June, July, and August). The mean values for sodium, potassium,  $\gamma$ -glutamyl transpeptidase, total bilirubin, alanine aminotransferase (ALT), aspartate aminotransferase, indirect bilirubin, and direct bilirubin were calculated for 2 years preceding the pandemic (2018 and 2019). Emergency department outcomes were noted as discharge, hospitalization, and refusal of hospitalization or hemodialysis treatment.

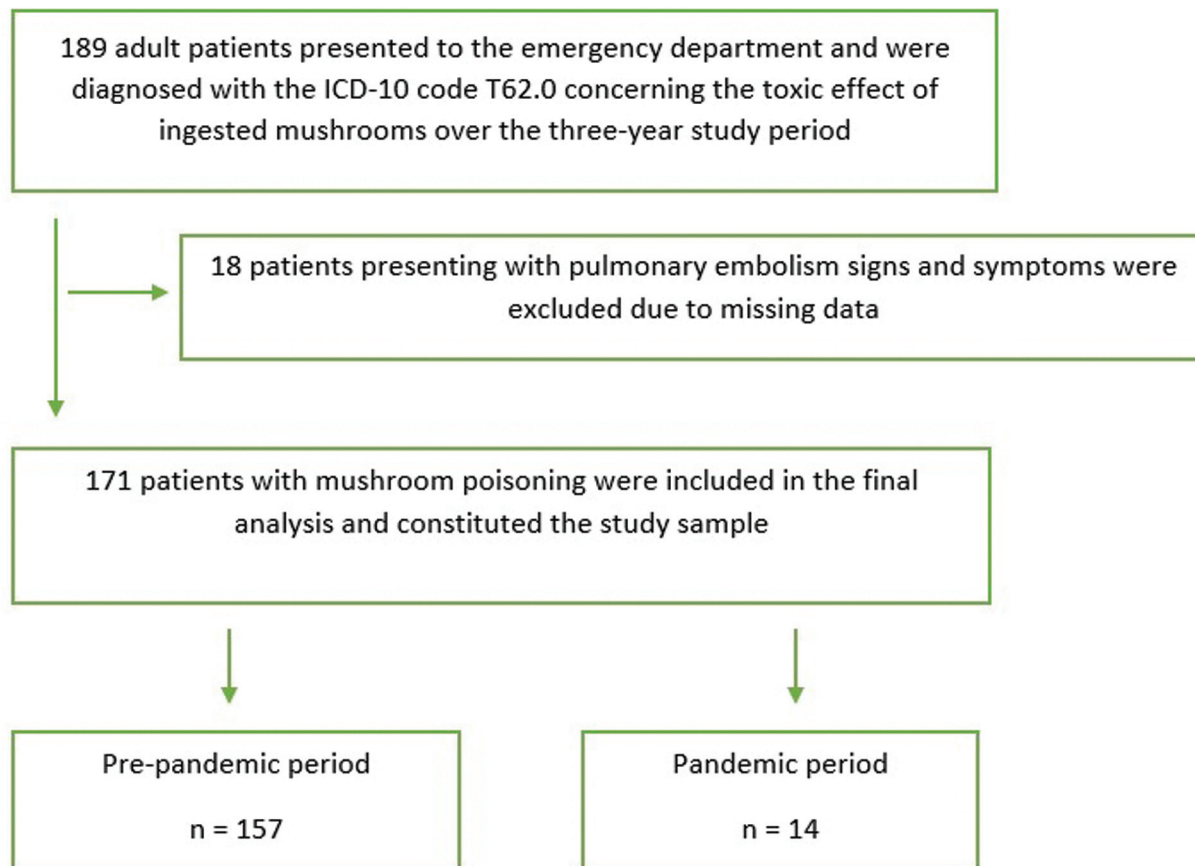
## Statistical Analysis

We used IBM SPSS Statistics for Mac, IBM Corp, Version 27.0, Armonk, New York, United States to perform statistical analyses. To evaluate the conformance of variables to the normal distribution, the Kolmogorov–Smirnov's test was conducted. The nonnormally distributed data were expressed as median and 25th to 75th percentile values, and the data that conformed to the normal distribution were presented with mean and standard deviation values. Categorical data were presented as the number of cases and percentages.

Although the first case was seen in our country and the declaration of the pandemic was March 11, 2020, the effects of the government's reactions and measures on the social behavior began in January 2020.<sup>3</sup> For this reason, the first months of 2020 were also evaluated within the effects of the pandemic. To understand the impact of the pandemic, the data for 2020 and the average data for 2019 and 2018 were compared. For the comparison of qualitative and quantitative data between the two groups, the chi-square and Mann–Whitney's *U* tests were used. The *p*-value of 0.05 was considered as a cutoff point for statistical significance.

## Results

Of the 171 patients included in the final analysis, 69 (42.3%) were male. The median age was 39 (25th–75th percentile: 28–53) years. The baseline characteristics of the enrolled patients are shown in **Table 1**, and the seasonal distribution of the mushroom poisoning cases presenting to the emergency department from 2018 to 2020 is shown in **Fig. 2**. The number of patients hospitalized due to mushroom poisoning was 49 (51%) in 2018, 28 (45.9%) in 2019, and 8 (57.1%) in 2020. Nineteen (19.9%) patients were discharged in 2018, 15 (24.5%) in 2019, and 1 (7.1%) in 2020. Twenty-eight (29.1%) patients in 2018, 18 (29.5%) in 2019, and 5 (35.7%) in 2020 refused hospitalization or hemodialysis



**Fig. 1** Flowchart of the study.

treatment. Hemodialysis was applied to 39 (39.5%) patients in 2018, 21 (34.4%) in 2019, and 6 (42.8%) in 2020.

Only one patient died due to the toxic effect of ingested mushrooms during hospitalization (in 2018). Transaminase levels were elevated in the initial tests in two patients in 2018 and in two patients in 2019. No elevation of transaminases was observed in initial test of the patients in 2020. The comparisons of the baseline characteristics between the pre-pandemic and pandemic periods are shown in [Table 2](#). In the pre-pandemic period, the average number of patients presenting with mushroom poisoning per year was 78.5. In the pandemic period, 14 patients presented with mushroom poisoning annually. There was a 5.6-fold decrease in the number of patients presenting with mushroom poisoning during the pandemic.

## Discussion

In this retrospective study, we evaluated the effect of the COVID-19 pandemic on emergency department presentations with mushroom poisoning. To this end, we compared the average number of presentations during the pre-pandemic and pandemic periods. According to our results, there was a 5.6-fold decrease in the number of patients presenting with mushroom poisoning. To the best of our knowledge, this was the first study to evaluate the effect of the COVID-19 pandemic on mushroom poisoning in Turkey. Contrary to the

literature, we found a decrease in mushroom poisoning cases during the pandemic.

We think that one of the logical explanations for the results of our study may be the change in people's hospital admission habits during the pandemic period. During the pandemic, there have been changes in the patient characteristics of emergency departments. While the number of patients presenting with COVID-19-like symptoms increased, presentations involving non-COVID-19-like symptoms have decreased considerably.<sup>10</sup> Another possible logical explanation for our results might be the changes in people's eating habits. The COVID-19 pandemic and its restrictive measures have also resulted in the modification of the eating habits of individuals. It has drastically changed food shopping behaviors, and the resulting economic recession has caused concerns over food availability. During lockdowns implemented, people have started to consume more pasta and canned goods than green vegetables, which has led to the increased incidence of nutritional disorders.<sup>11,12</sup>

Changes have also been reported in cases of mushroom poisoning due to altered nutritional habits and emergency patient characteristics. Li et al called mushroom poisoning cases in China mushroom poisoning outbreaks. They reported 24 new species of mushroom causes poisoning, a case of shiitake mushroom dermatitis, and mortality in one case due to *Paxillus involutus*. Li et al recommended promoting awareness concerning the safe consumption of

**Table 1** Baseline characteristics of the enrolled patients according to years

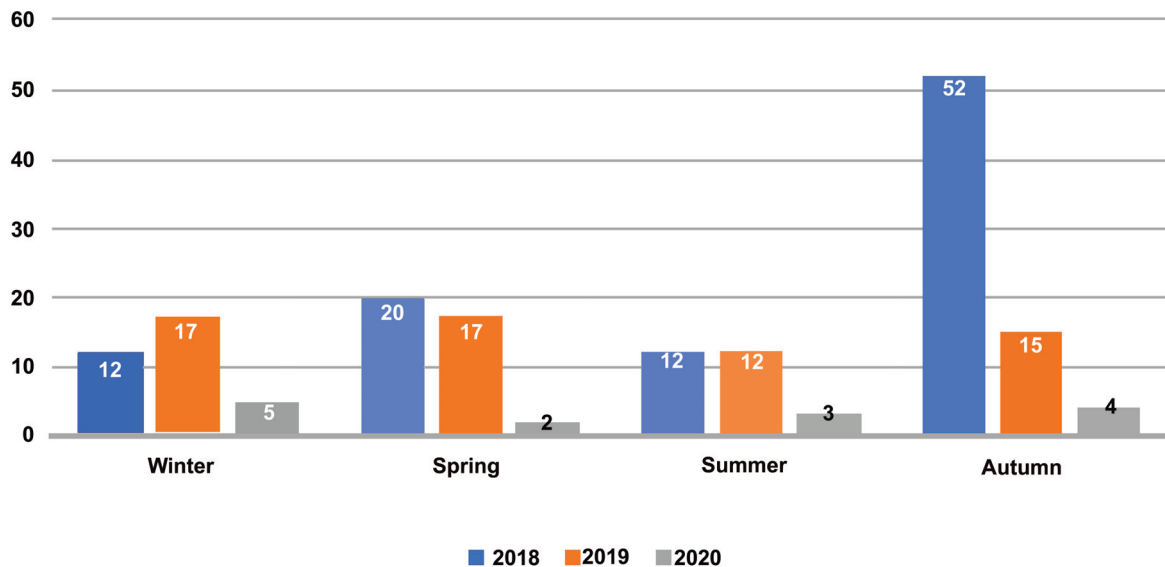
| Variables  | 2018 (n = 96)    | 2019 (n = 61)    | 2020 (n = 14)    |
|--|------------------|------------------|------------------|
| Age (y), median (25th–75th quarters)             | 39 (28–53)       | 40 (33–54.5)     | 39 (27.75–28.25) |
| Gender, n (%)                                    |                  |                  |                  |
| Male   | 40 (41.7%)       | 25 (41%)         | 4 (28.6%)        |
| Female   | 56 (58.3%)       | 36 (59%)         | 10 (71.4%)       |
| Season, n (%)                                    |                  |                  |                  |
| Winter   | 12 (12.5%)       | 17 (27.9%)       | 5 (35.7%)        |
| Spring   | 20 (20.8%)       | 17 (27.9%)       | 2 (14.3%)        |
| Summer   | 12 (12.5%)       | 12 (19.7%)       | 3 (21.4%)        |
| Autumn   | 52 (54.2%)       | 15 (24.6%)       | 4 (28.6%)        |
| Laboratory findings, median (25th–75th quarters) |                  |                  |                  |
| Aspartate aminotransferase (U/L)                 | 23 (19–29.25)    | 19 (16–25)       | 20 (17.75–21.75) |
| Alanine aminotransferase (U/L)                   | 19.5 (14–26)     | 19 (13.5–28.5)   | 14.5 (11–19)     |
| γ-glutamyl transpeptidase (U/L)                  | 18 (13–30)       | 20.5 (14–35.75)  | 16 (10–23)       |
| Total bilirubin (mg/dL)                          | 0.51 (0.33–0.79) | 0.51 (0.34–0.82) | 0.59 (0.43–1.49) |
| Direct bilirubin (mg/dL)                         | 0.18 (0.13–0.26) | 0.19 (0.13–0.29) | 0.22 (0.15–0.45) |
| Indirect bilirubin (mg/dL)                       | 0.35 (0.21–0.52) | 0.31 (0.21–0.53) | 0.37 (0.30–1.04) |
| Sodium (mEq/L)                                   | 138 (137–140)    | 139 (138–141)    | 139 (138–140)    |
| Potassium (mEq/L)                                | 4.4 (4.2–4.6)    | 4.3 (4.1–4.6)    | 4.3 (4.1–4.6)    |
| Emergency department outcomes, n (%)             |                  |                  |                  |
| Hospitalization                                  | 49 (51%)         | 28 (46%)         | 8 (57.1%)        |
| Refusal of treatment                             | 28 (29.1%)       | 18 (29.5%)       | 5 (35.7%)        |
| Discharge  | 19 (19.9%)       | 15 (24.5%)       | 1 (7.1%)         |
| Hemodialysis, n (%)                              | 39 (39.5%)       | 21 (34.4%)       | 6 (42.8%)        |
| Mortality, n                                     | 1                | 0                | 0                |

mushrooms to reduce related poisoning, but they did not comment on the reasons for this change in mushroom poisoning cases.<sup>8</sup> In another study, Lurie et al investigated the effect of the COVID-19 pandemic on mushroom poisoning cases in Israel. They showed a 5-fold increase compared with the same fall/winter period in 2019, as well as a 2.5-fold increase in the median annual rate from 2015 to 2019. They suggested that this might be due to favorable increased outdoor activities of the public and climate conditions in response to restrictions on other relaxation activities obligatory during the pandemic as an explanation of their results.<sup>9</sup> Contrary to these two studies, our sample indicated a 5.6-fold decrease in the median annual rate of mushroom poisoning cases during the pandemic compared with the pre-pandemic 2-year period. An explanation for this discrepancy may be that we used emergency department data in our study, while the other two studies evaluated data obtained from national poisoning information centers. Lurie et al reported that most cases had minor or no symptoms and signs.<sup>9</sup> We consider this particular patient group may not have presented to the emergency department due to the fear of contracting COVID-19. An-

other possible explanation is our study being conducted in a metropolitan city and not including national data and individuals' changing dietary habits in favor of storable foods, such as pasta and canned food.

### Limitations

The main limitation of our study was its retrospective nature. First, there may have been other risk factors that could not be measured due to the retrospective design. Retrospective studies cannot determine causation; they only evaluate association. Second, we only evaluated data obtained from an emergency department of a tertiary hospital located in a metropolitan city and did not include national data. The situation may be different in the countryside. Third, the poisonous mushroom species were not evaluated in our study; therefore, we were not able to determine whether there was a change in the poisoning characteristics similar to the previous study conducted in China.<sup>8</sup> Fourth, in our country, clinicians are obliged to report mushroom poisoning cases to law enforcement in accordance with local legal policies. The data of these cases



**Fig. 2** Seasonal distribution of mushroom poisoning cases presenting to the emergency department from 2018 to 2020.

**Table 2** Comparisons of baseline characteristics between the pre-pandemic and pandemic periods

| Variables  | 2018 and 2019 (n = 157) | 2020 (n = 14)    | p-Value |
|--|-------------------------|------------------|---------|
| Age (y), median (25th–75th quarters)             | 39 (31–53)              | 39 (27.75–28.25) | 0.616   |
| Gender, n (%)                                    |                         |                  |         |
| Male   | 65 (41.4%)              | 4 (28.6%)        | 0.348   |
| Female   | 92 (58.6%)              | 10 (71.4%)       |         |
| Season, n (%)                                    |                         |                  |         |
| Winter   | 29 (18.5%)              | 5 (35.7%)        | 0.343   |
| Spring   | 37 (23.6%)              | 2 (14.3%)        |         |
| Summer   | 24 (15.3%)              | 3 (21.4%)        |         |
| Autumn   | 67 (42.7%)              | 4 (28.6%)        |         |
| Laboratory findings, median (25th–75th quarters) |                         |                  |         |
| Aspartate aminotransferase (U/L)                 | 21 (18–28)              | 20 (17.75–21.75) | 0.283   |
| Alanine aminotransferase (U/L)                   | 19 (14–27)              | 14.5 (11–19)     | 0.038   |
| γ-glutamyl transpeptidase (U/L)                  | 19 (14–34)              | 16 (10–23)       | 0.179   |
| Total bilirubin (mg/dL)                          | 0.51 (0.33–0.80)        | 0.59 (0.43–1.49) | 0.129   |
| Direct bilirubin (mg/dL)                         | 0.18 (0.13–0.26)        | 0.22 (0.15–0.45) | 0.237   |
| Indirect bilirubin (mg/dL)                       | 0.33 (0.21–0.53)        | 0.37 (0.30–1.04) | 0.124   |
| Sodium (mEq/L)                                   | 139 (137–141)           | 139 (138–140)    | 0.776   |
| Potassium (mEq/L)                                | 4.4 (4.1–4.6)           | 4.3 (4.1–4.6)    | 0.555   |

are considered forensic data. Therefore, clinicians are careful while recording the data of mushroom poisoning cases. On the other hand, this legal obligation may have encouraged patients to give incorrect information. Another limita-

tion of our study was the high number of patients who refused treatment. Due to the clinical practices of our hospital, we follow up the patients by hospitalizing them more. Before hospitalization, patients are told that

applications such as hemodialysis will be performed. Patients who have already become asymptomatic with symptomatic treatment in the emergency department refuse hospitalization and hemodialysis. Another explanation for about one-third of patients' refusal to receive treatment may be the low level of health literacy in our country, as in the rest of the world.<sup>13</sup> Finally, our study had a single-center design, and therefore, our results cannot be generalized to other health care institutions.

## Conclusion

In conclusion, our results indicated a 5.6-fold decrease in the number of patients presenting to the emergency department with mushroom poisoning. This may be due to the changes in the eating habits of individuals during the pandemic and our study being conducted in a metropolitan city. We recommend that multicenter studies be performed to verify the data obtained from our study and increase their generalizability.

### Ethical Approval

Ethical approval with approval number 270 and date September 30, 2021 was obtained from the local ethics committee. We retrospectively reviewed secondary data recorded from the computer-based patient data system of the hospital, and these data did not include any personal identifiable information. Therefore, informed consent was waived.

### Funding

None.

### Conflict of Interest

None declared.

## References

- 1 Ozdemir S, Kokulu K, Algin A, Akca HS. Demographic and clinical characteristics of applications to the emergency service with mushroom intoxication. *Eurasian J Tox.* 2019;1(02):49–52
- 2 Akkuzu MZ, Sezgin O, Yaraş S, et al. Mersin'de Yabani Mantar Zehirlenmeleri: Retrospektif bir Epidemiyolojik Çalışma ve Karaciğer Toksisitesinin İncelenmesi. *Van Sag Bil Derg* 2020;13(03):10–14
- 3 Eroglu SE, Aksel G, Altunok I, et al. Can Google® trends predict emergency department admissions in pandemic periods? *Med Sci (Turkey)* 2021;10(01):111–117
- 4 Özdemir S. Patient with profound anemia due to hemorrhoids during the pandemic period. *J Coll Physicians Surg Pak* 2021;31 (Suppl 3):s160
- 5 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
- 6 Göksoy B, Akça MT, İnanç ÖF. The impacts of the COVID-19 outbreak on emergency department visits of surgical patients. *Ulus Travma Acil Cerrahi Derg* 2020;26(05):685–692
- 7 Castagneto-Gissey L, Casella G, Russo MF, et al. Impact of COVID-19 outbreak on emergency surgery and emergency department admissions: an Italian level 2 emergency department experience. *Br J Surg* 2020;107(10):e374–e375
- 8 Li H, Zhang H, Zhang Y, et al. Mushroom poisoning outbreaks - China, 2020. *China CDC Wkly* 2021;3(03):41–45
- 9 Lurie Y, Lewinsohn D, Kurnik D. An outbreak of mushroom poisoning in Israel during the 2020 fall and winter season: an unexpected outcome of COVID-19 restrictions? *Clin Toxicol (Phila)* 2022;60(03):386–388
- 10 Özdemir S, Algin A. How will the health literacy and crowded emergency room be affected after the COVID-19 pandemic? *Phnx Med J.* 2021;3(01):50
- 11 Litton MM, Beavers AW. The relationship between food security status and fruit and vegetable intake during the COVID-19 pandemic. *Nutrients* 2021;13(03):712
- 12 Herle M, Smith AD, Bu F, Steptoe A, Fancourt D. Trajectories of eating behavior during COVID-19 lockdown: longitudinal analyses of 22,374 adults. *Clin Nutr ESPEN* 2021;42:158–165
- 13 Ozdemir S, Akça HŞ, Algin A, Kokulu K. Health literacy in the emergency department: a cross-sectional descriptive study. *Eurasian J Emerg Med.* 2020;19(02):94–97