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CLINICAL FEATURE
ORIGINAL RESEARCH

# The knowledge level and perceptions toward COVID-19 among Turkish final year medical students

Fatih Çalışkan [a], Özlem Mıdık [b], Zeynep Baykan [c], Yeşim Şenol [d], Esra Çınar Tanrıverdi [e], Funda İfakat Tengiz [f] and Albena Gayef [g]

[a]Department of Emergency Medicine, Faculty of Medicine, Ondokuz Mayıs University, Samsun, Turkey; [b]Department of Medical Education, Faculty of Medicine, Ondokuz Mayıs University, Samsun, Turkey; [c]Department of Medical Education, Faculty of Medicine, Erciyes University, Kayseri, Turkey; [d]Department of Medical Education, Faculty of Medicine, Akdeniz University, Antalya, Turkey; [e]Department of Medical Education, Faculty of Medicine, Atatürk University, Erzurum, Turkey; [f]Department of Medical Education, Faculty of Medicine, Katip Çelebi University, İzmir, Turkey; [g]Department of Medical Education, Faculty of Medicine, Trakya University, Edirne, Turkey

**ABSTRACT**

**Background:** Coronavirus disease 2019 (COVID-19) has upended medical education as well as the lives of healthcare professionals. Higher education institutions have a crucial role in the solution of public health problems by training young doctor candidates, and it is also essential to increase the knowledge level of physician candidates about the epidemic. So, in this study, we aimed to examine Turkish final year medical students' knowledge level and perceptions toward the COVID-19 pandemic.

**Methods:** The present descriptive multicentered study was conducted with the medical students in the final year of six medical schools located in six geographic regions of Turkey. After ethical approval, data were gathered using an online questionnaire through Google forms between 10 April 2020, and 20 April 2020.

**Results:** In this national survey study, 860 volunteers answered the questions thoroughly. The median age was 24 (22–38) years. A total of 55.3% of the participants were female. The median knowledge level score was 69.0 (0–93.1). The knowledge level was moderate. A total of 34.2% of the participants had a high level of knowledge. A total of 48.7% of participants stated that they felt the most competent about performing CPR. Updates about COVID-19 were followed regularly by 84.5% of the participants.

**Conclusion:** We determined that final year medical students are knowledgeable and aware of this pandemic. We, medical educators, should inculcate relevant knowledge and educate the medical students to improve practices in the current pandemic, as well as for future epidemics. Different learning techniques should be added to the curriculum, especially at the time which widespread panic and uncertainty are prevalent.

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COVID-19; internship; medical education; undergraduate; knowledge; perceptions

## 1. Introduction

Coronavirus disease 2019 (COVID-19) has emerged as a global public health crisis. As of 15 April 2020, the number of COVID-19 cases has reached nearly 2 million worldwide, affecting 185 countries [1–3]. In Turkey, the first known case of COVID-19 was detected on 11 March 2020 [4]. This coincides with the date the World Health Organization (WHO) declared COVID-19 a pandemic [5].

COVID-19 patients show symptoms such as severe acute respiratory distress and kidney failure, which can lead to death in severe cases. Reportedly, asymptomatic individuals may be contagious because the virus has been detected in their respiratory secretions during this presymptomatic period [6].

The COVID-19 pandemic has upended medical education as well as the lives of healthcare professionals. Because of widespread uncertainty and disagreement about the appropriate roles of medical students during a pandemic, student participation in clinical care has varied across institutions [7]. However, it is crucial for these institutions to take the necessary measures to ensure adequate training for new doctors and medical students. This is required either when they return to medical school before graduation or for their postgraduate qualification.

The fact that medical students are learners, not certified practitioners, increases the number of unnecessary risks for patients and the responsible educative clinicians. During the COVID-19 pandemic, medical students may increase risks, such as the transmission of the virus, and the need to use more personal protective equipment (PPE), which has become difficult to obtain. Furthermore, medical students also increase the workload of physicians who play an active role in the field educating them. In this time of COVID-19, students are exposed to a contagion they would not typically encounter during their medical education. However, we know that medical students played an active role in

**CONTACT** Fatih Çalışkan mdfcaliskan@gmail.com; fatih.caliskan@omu.edu.tr Department of Emergency Medicine, Faculty of Medicine, Ondokuz Mayıs University, Samsun 55139, Turkey

patient care during the Spanish flu pandemic in 1918 and the polio epidemic in 1952 in Denmark [8,9].

As healthcare workers remain on the front line of the effort to contain the COVID-19 pandemic, many of them have contracted the virus in the process, leading to a shortage of healthcare professionals, thereby increasing the demand for their services. In response, medical schools in the United States, Italy, and the United Kingdom are graduating thousands of medical students early. Thus, medical students are often serving as frontline clinicians to boost healthcare systems around the world struggling to cope with COVID-19 [7]. We believe it is essential to determine the level of knowledge and perceptions of competence of these students in light of the potential for interns graduating and then being invited into the field or into medical faculties they have studied at because of the uncertainty about how the pandemic will progress in Turkey.

Similarly, because of the importance in not delaying the graduation from medical school and enabling new doctors to join the workforce in the summer, Turkey's Council of Higher Education updated its decision about the interruption of higher education on 16 March 2020. Under the revised decision, medical students can perform their internships in family medicine and public health units affiliated with the Ministry of Health or in their medical schools [10].

Higher education institutions play a crucial role in resolving public health problems through training new and dynamic doctors; however, it is also essential for institutions to increase their medical students' knowledge about the pandemic.

According to data from the severe acute respiratory syndrome (SARS) outbreak in 2002, healthcare workers accounted for 21% of all infections worldwide [11]. By extension, it is likely that a healthcare personnel crisis could also occur during the COVID-19 pandemic, making it essential for the healthcare system to utilize medical students before the system suffers a personnel shortage. Consequently, it is vital to determine the knowledge level and perceptions that final year (sixth year) medical students have about COVID-19. Thus, this study examined these medical students' knowledge level of and perceptions about COVID-19.

## 2. Materials and methods

### 2.1. Ethical statement

The Clinical Research Ethics Committee of the Ondokuz Mayıs University Faculty of Medicine approved this study (OMU CREC protocol no: 2020/152).

### 2.2. Study design and population

Although the internship duration varies according to medical faculties this year, intern rotations are in emergency, internal medicine, gynecology, psychiatry, pediatrics, general surgery, public health, and family medicine. Overall, 1,541 final year medical students from six medical schools in six culturally and geographically different regions of Turkey participated in this descriptive, multicentered study. The medical schools were Akdeniz University, Atatürk University, Erciyes University, Izmir Katip Çelebi University, Ondokuz Mayıs University, and Trakya University. We determined the sample size calculation according to a 5% acceptable error using the sample calculation formula whose universe is known. We then calculated the number of samples needed from each medical school according to the total number of the students enrolled at each. According to this formula, we required a sample of at least 308 individuals to achieve a 95% confidence interval (CI).

After receiving ethical approval for the study, we collected data via a 48-question online survey on Google Forms from April 10–20, 2020. The survey link was sent via e-mail to all final year medical students at the six medical schools, with 860 students completing the survey. Taking into account that these students consider themselves as both doctors and students and the necessity for these students to play a role in the pandemic process, we measured their beliefs and competence perceptions. The survey consisted of three main sections: questions about the participants' socio-demographic characteristics, participants' experiences of illness and their beliefs about the disease, and participants' self-evaluation about their perceptions of competence and knowledge about COVID-19 in the roles they could take if they were to join the healthcare workforce fighting the virus. Competence perceptions were evaluated as 'I can' and 'Cannot do' based on the skills students could be asked to perform.

A group composed of an infectious disease specialist, two epidemiologists, two medical educators, and an emergency physician used the WHO COVID-19 guidelines and the guidelines from the Public Health Division of Turkey's Ministry of Health to prepare the questions measuring the medical students' level of knowledge [4,5]. We ensured that the informational questions in the survey were specifically about students' roles (patient triage, counseling, etc.) and measures to protect themselves from infection. Researchers in the medical faculties where the study would be conducted reviewed the questionnaire, and we made arrangements according to their suggestions on question clarity.

We assessed the students' level of knowledge about COVID-19 using 29 questions consisting of general information about COVID-19 (11 items), swab sampling (seven items), personal protective precautions (six items), and precautions to take during cardiopulmonary resuscitation (CPR) of COVID-19 positive/suspicious patients (five items). A correct answer was assigned 1 point. Incorrect and 'I have no idea' answers were assigned 0 points. We then converted the total knowledge level score into a percentile. A score of ≥75% was defined as a 'high' knowledge level, a score of 50–75% was defined as 'moderate,' and a score of ≤50% was defined as 'low' [12].

### 2.3. Statistical analysis

We used IBM® SPSS® Statistics V21 software for statistical analysis of the data. We expressed data as mean ± standard deviation (SD), median (minimum-maximum), and number (%) after we determined whether the data were parametric or non-parametric. We used the Kolmogorov–Smirnov test to evaluate the conformity of the quantitative data distribution to a normal distribution. We determined that it would be appropriate to use non-parametric tests for data analysis in

this study. We next used the Mann–Whitney U test for binary groups, and the Kruskal–Wallis test for comparisons of more than two groups. We used the Chi-square test to evaluate the relationships between the categorical variables. The statistical significance level was accepted as $p < 0.05$ for all tests.

## 3. Results

### 3.1. Sociodemographic findings

A total of 860 (55.9%) final year medical students (n = 1,541) completed the survey. The average age of participants was 24.4 ± 1.4 years with 55.3% identifying as female. In addition, 825 of the participants were Turkish medical students while 35 were international students from 12 countries. Turkish was the primary language used by the participants in their medical education (92.8%) with the remaining using English (7.2%). Only 13 participants (1.5%) reported having been in contact with COVID-19-positive patients.

### 3.2. Perceptions of the COVID-19 pandemic

When answering the question 'Are you afraid of getting infected with COVID-19?' 556 (64.7%) medical students responded affirmatively. Although 368 (42.8%) participants believed that the COVID-19 pandemic could be fully controlled in Turkey, 204 (23.7%) said they believed it could not be controlled, and 288 (33.5%) said they had no idea whether it could be fully controlled. While less than half of the participants (42.8%) said they believed the pandemic would end within six months, a majority of them (59%) expressed the belief that Turkey would win the fight against COVID-19. The distribution of the perceptions about the COVID-19 pandemic is shown in Table 1.

When answering the question 'What would you feel if you are called to work in an emergency service?' 520 of the participants reported worrying that their medical education had not adequately prepared them to deal with COVID-19. Furthermore, 196 of participants said they believed that their work in the emergency room would lead to an increase in the workload in the department. Of all participants, 449 stated that they would feel happy if they were called to work in the emergency department, with 294 defining happiness as a 'feeling of usefulness' and 377 as 'being a doctor.'

The analysis of participants who selected 'other' as their response to the question about being called to work in an emergency service ($n$ = 125) showed that 32 of them were worried about infecting their relatives (2.1% of all participants), 26 were worried about performing non-medical tasks, such as assisting healthcare personnel instead of being an emergency department physician (1.7% of all participants), and 21 feared they would become infected with COVID-19 (1.3% of all participants).

The question 'How would you define your level of competency on COVID-19 if you are called to work in the emergency room now?' asked participants their opinions about their competencies. Their responses included: 'I am not enough by any means' (24.3%), 'I can do CPR' (48.7%), 'I can do triage' (34.4%), 'I can manage a suspicious COVID-19 case' (19%), 'I can obtain a sample for COVID-19' (17%), 'I can take personal protective measures' (31.5%), 'I do oxygenation' (26.4%), 'I can perform intubation' (14.9%), 'I can apply symptomatic treatment' (26.4%), and 'I can order pneumonia treatment' (14.1%).

**Table 1.** The distribution of perceptions about COVID-19 ($n$ = 860).

| Variables | n (%) |
|---|---|
| Do you have any contact with COVID-19 positive patient? | |
| Yes | 13 (1.5) |
| No | 532 (61.9) |
| Unknown | 315 (36.6) |
| Are you afraid of getting infected of COVID-19 disease? | |
| Yes | 556 (64.7) |
| No | 210 (24.4) |
| Unknown | 94 (10.9) |
| Do you believe that the COVID-19 pandemic can be fully controlled in Turkey? | |
| Yes | 368 (42.8) |
| No | 204 (23.7) |
| Unknown | 288 (33.5) |
| How long do you think the pandemic will last? | |
| 1 month | 7 (0.8) |
| 3 months | 258 (30) |
| 6 months | 368 (42.8) |
| 12 months | 125 (14.5) |
| >1 year | 102 (11.9) |
| Do you believe that Turkey will win the fight against the COVID-19 virus? | |
| Yes | 507 (59) |
| No | 69 (8) |
| I'm not sure | 284 (33) |

### 3.3. Final year medical students' COVID-19 knowledge level

The median knowledge level score among the survey participants was 69.0 (min: 0; max: 93.1); thus, their knowledge overall was categorized as 'moderate.' Specifically, 34.2% of all participants displayed a 'high' level of knowledge (≥75%) while 8.2% had a 'low' level of knowledge (≤50%).

There was a statistically significant difference in the COVID-19 knowledge levels of students who were afraid of contracting the disease ($\chi^2$ = 8.361, p = 0.015). While 82.5% of those with a low level of knowledge reported being afraid of becoming infected, of those with a moderate level of knowledge, 74.5% said they were afraid of infection while 66.8% with a high level of knowledge expressed the same fear. Additionally, a statistically significant difference was found in the perceptions of competence according to knowledge levels, with those respondents with a low level of knowledge reporting feelings of inadequacy. The distribution of answers to the questions about the level of knowledge about COVID-19 is shown in Table 2.

The true/false question 'The death cases reported so far are generally children and young adults' was answered correctly by most of the students (96.5%). However, the correct responses to the questions about taking a swab sample to diagnose COVID-19 ranged between 25.5% and 92.3%. The correct responses to the questions about the rational use of PPE and disinfecting agents ranged from 7.3% to 95.3%. The true/false question 'A healthcare worker standing 1 meter closer to certain/possible COVID-19 cases should wear gloves, a mask, a face shield, and goggles and use an N95/FFP2 or N99/FFP3 mask during procedures that cause aerosolization' was answered correctly by nearly all of the students (95.3%) as

**Table 2.** The level of knowledge on COVID-19 among study participants ($n$ = 860).

| | True n (%) | False n (%) | No idea n (%) |
|---|---|---|---|
| General Information | | | |
| The virus is named as SARS-CoV-2 due to its similarity to SARS-CoV. | 664 (77.2) | 78 (9.1) | 118 (13.7) |
| SARS-CoV is transmitted to humans from civet cats. | 189 (22) | 376 (43.7) | 295 (34.3) |
| The main symptoms of COVID 19 include runny nose and sputum. | 762 (88.6) | 50 (5.8) | 48 (5.6) |
| People who contact with infected people with the COVID 19 should be isolated immediately. In general, the observation period is 14 days. | 818 (95.1) | 16 (1.9) | 26 (3) |
| The disease is transmitted mainly through respiratory droplets. | 777 (90.3) | 54 (6.3) | 29 (3.4) |
| The virus can be detected in the respiratory secretions of asymptomatic people and the main infection is transmitted from asymptomatic individuals. | 45 (5.2) | 751 (87.3) | 62 (7.2) |
| The contamination time of the COVID-19 and the time to withstand the external environment are not clearly known for now. | 647 (75.2) | 133 (15.5) | 80 (9.3) |
| Death cases reported so far are generally children and young adults. | 830 (96.5) | 2 (0.2) | 28 3.3 |
| The asymptomatic source of transmission is usually the elderly. | 793 (92.2) | 13 (1.5) | 54 (6.3) |
| Confirmed cases for COVID-19 are cases with SARS-CoV-2 detected by molecular methods among the cases that conform to the possible case definition.* | 514 (59.8) | 318 (37) | 28 (3.3) |
| As soon as the possible case is identified, the Provincial Health Directorate Infectious Diseases Unit is first informed.* | 93 (10.8) | 535 (62.2) | 232 (27) |
| The Swab Sampling for COVID-19 disease | | | |
| The sample is taken with Viral Transport Media (VTM) as respiratory tract swab. | 589 (68.5) | 11 (1.3) | 260 (30.2) |
| All samples should be stored in the refrigerator (between 2–80$^0$C) immediately after being collected and delivered to the laboratory immediately. | 454 (52.8) | 34 (4) | 372 (43.3) |
| Nasopharyngeal washing sample or nasal and/or oropharyngeal swab should be taken from cases without lower respiratory symptoms. | 470 (54.7) | 92 (10.7) | 298 (34.7) |
| The oropharyngeal and nasal swab sample taken from the same patient should be sent in separate growth culture. | 219 (25.5) | 325 (37.8) | 316 (36.7) |
| The first sample taken from people who conform to the possible case definition and those whose infection findings continue, is the upper respiratory tract sample and the test result is negative; COVID-19 excludes suspicion of infection. | 684 (79.5) | 34 (4) | 142 (16.5) |
| Healthcare worker should wear personal protective equipment (at least N95/FFP2 mask, goggles or face protection) when taking samples. | 794 (92.3) | 5 (0.6) | 61 (7.1) |
| If a membrane, white spots or inflamed/hyperemic areas are seen on the tonsils, the sample is taken after gently cleaning with an antiseptic before taking a throat swab sample.* | 346 (40.2) | 215 (25) | 299 (34.8) |
| Personel protective precautions against the COVID-19 | | | |
| Beard must be cut. | 577 (67.1) | 79 (9.2) | 204 (23.7) |
| Personal belongings such as jewelry, rings, necklaces, earrings, watches, stethoscope should be left at home or in a hospital environment due to the risk of contamination. | 774 (90) | 26 (3) | 60 (7) |
| Uniforms such as jerseys, slippers and gowns should be removed at the hospital at the end of the shift and then washed in the hospital laundry room and handed over to people at the next shift. | 604 (70.2) | 111 (12.9) | 145 (16.9) |
| No materials including electronic equipment used in the workplace, should be taken on the way home. | 545 (63.4) | 160 (18.6) | 155 (18) |
| The healthcare worker who will come closer to 1 meter closer to certain/possible COVID-19 cases should wear gloves, a mask, a face shield, goggles and use the N95/FFP2 or N99/FFP3 mask during procedures to cause aerosolization. | 820 (95.3) | 9 (1) | 31 (3.6) |
| Household bleach (at 1: 100 normal dilution) should be used for white laundry.* | 63 (7.3) | 279 (32.4) | 518 (60.2) |
| Precautions during Cardiopulmonary Resuscitation of COVID-19 positive patients | | | |
| There should be no more person other than the medical personnel who are absolutely in necessary number during procedures that may cause aerosolization such as CPR. | 741 (86.2) | 23 (2.7) | 96 (11.2) |
| Intubation should be performed by the most experienced person in the emergency room. | 774 (90) | 23 (2.7) | 63 (7.3) |
| There is no need to wash hands before and after contact with the patient. | 784 (91.2) | 28 (3.3) | 48 (5.6) |
| N95/FFP2 or N99/FFP3 mask should be used during the processes that may cause aerosolization. | 819 (95.2) | 6 (0.7) | 35 (4.1) |
| The healthcare professional who intubated a COVİD-19 patient should be quarantined for 14 days. | 548 (63.7) | 86 (10) | 226 (26.3) |
| TOTAL | 860 (69.0) | | |

All questions are True/False typed, except for the multiple-choice questions masked as '*.'

was the true/false question 'Healthcare workers should wear PPE (at least N95/FFP2 mask, goggles, or face protection) when taking samples' (92.3%). The correct responses to the questions about the precautions to take while performing CPR on patients with COVID-19 ranged from 63.7% to 95.2%.

The differences in the level of knowledge about the significant variables are shown in Table 3. The distribution of the median knowledge levels by gender did not differ (U = 84,929; $p$ = 0.073) (Table 3). There was a statistically significant difference among participants based on their level of knowledge, with participants having a moderate level of knowledge reporting being afraid of getting infected while those with a higher level of knowledge reporting not being afraid. (U = 49,647; $p$ = 0.001) (Table 3).

In terms of the participants' knowledge level about COVID-19, 74.9% stated that their knowledge level was 'low,' and 4.1% of the participants said did not know about the disease. When comparing the level of knowledge about COVID-19 based on the participants' self-assessment, there was a significant statistical difference between the participants with a low level of knowledge about COVID-19 and those with a high level of knowledge about the disease ($\chi^2$ = 89.562; $p \leq 0.001$) (Table 3).

Updates about COVID-19 were followed regularly by 84.5% of the participants (Table 2), and there was a significant statistical difference in the level of knowledge according to the item 'Following the updates regularly about the COVID-19' (U = 71,121.0; $p \leq 0.001$) (Table 3).

**Table 3.** Differences in the level of knowledge according to the major variables (n = 860).

| | | | The Level Of Knowledge Range 0–100 | | | | |
|---|---|---|---|---|---|---|---|
| | | | n (%) | Median (min-max) | Mean Rank | Test Statistics | p |
| Gender | | Female | 476 (55.3) | 69.0 (0–93.1) | 416.92 | U = 84,929 | 0.073 |
| | | Male | 384 (44.7) | 72.4 (0–93.1) | 447.33 | | |
| Afraid of becoming infected | | No | 210 (24.4) | 72.4 (20.7–93.1) | 425.09 | U = 49,647 | 0.001 |
| | | Yes | 556 (64.6) | 69.0 (0–93.1) | 367.79 | | |
| Self-assessment on the level of knowledge about COVID-19 | | Nothing | 35 (4) | 13.8 (0–75.9)[a] | 132.76 | $\chi^2$= 89.562 | ≤0.001 |
| | | Low | 644 (74.9) | 69.0 (0–93.1)[b] | 415.51 | | |
| | | High | 181 (21.1) | 75.9 (13.8–93.1)[c] | 541.40 | | |
| Education before the start of pandemic in Turkey | | No | 790 (91.8) | 69.0 (0–93.1) | 425.90 | U = 24,017 | 0.067 |
| | | Yes | 70 (8.2) | 72.4 (44.8–89.7) | 482.40 | | |
| Education after the start of pandemic in Turkey | | No | 812 (94.4) | 69.0 (0–93.1) | 425.70 | U = 15,591 | 0.019 |
| | | Yes | 48 (5.6) | 72.4 (44.8–93.1) | 511.69 | | |
| Type of education | | Face-to-Face | 28 (3.3) | 75.9 (48.3–89.7)[a] | 536.00 | $\chi^2$= 7.025 | 0.030 |
| | | Distance Education | 35 (4.1) | 72.4 (44.8–93.1)[ab] | 481.11 | | |
| | | No education | 797 (92.7) | 69.0 (0–93.1)[b] | 424.57 | | |
| Source of information | WHO official website | No | 576 (69) | 69.0 (0–93.1) | 403.99 | U = 66,522.5 | ≤0.001 |
| | | Yes | 284 (31) | 72.4 (0–93.1) | 484.27 | | |
| | Ministry of Health official website | No | 259 (29.2) | 69.0 (0–89.7) | 369.62 | U = 62,062 | ≤0.001 |
| | | Yes | 601 (69.8) | 72.4 (0–93.1) | 456.74 | | |
| | Chamber of Medical Doctors official website | No | 698 (81.1) | 69.0 (0–93.1) | 419.80 | U = 49,069.5 | 0.008 |
| | | Yes | 162 (18.9) | 72.4 (0–93.1) | 476.60 | | |
| | Biomedical literature website such as Pubmed | No | 722 (84) | 69.0 (0–93.1) | 417.99 | U = 40,786.5 | 0,001 |
| | | Yes | 138 (16) | 72.4 (34.5–93.1) | 495.95 | | |
| | Social media | No | 218 (25.4) | 72.4 (0–93.1) | 475.67 | U = 60,130.5 | 0.002 |
| | | Yes | 642 (74.6) | 69.0 (0–93.1) | 415.16 | | |
| Reading the National COVID-19 Infection Guide. | | No | 425 (49.4) | 69.0 (0–93.1) | 380.34 | U = 71,121 | ≤0.001 |
| | | Yes | 435 (50.6 | 72.4 (0–93.1) | 479.50 | | |
| Following the updates regularly about COVID-19 | | No | 133 (15.5) | 62.1 (0–93.1) | 316.01 | U = 33,118 | ≤0.001 |
| | | Yes | 727 (84.5) | 72.4 (0–93.1) | 451.45 | | |

U = Mann Whitney U Test; $\chi^2$= Kruskal-Wallis Test; a-c: There is no difference between groups with the same letter

While 70 participants (8.1%) had received training about COVID-19 before the pandemic hit Turkey, 790 (91.8%) reported receiving no training before the pandemic arrived in Turkey. Only 48 participants (5.6%) said they received training about COVID-19 after the virus was detected in Turkey. When the level of knowledge was compared to the presence of COVID-19 training before and after the start of the pandemic in Turkey, the only significant statistical difference was seen in the group that received training after the start of pandemic ($p$ = 0.067; $p$ = 0.01, respectively) (Table 3). Of the 118 survey participants who received COVID-19 training after the pandemic hit Turkey, 28 had participated in a face-to-face COVID-19 training course and 35 had undergone training via distance learning. There was a significant statistical difference between the type of course and the level of knowledge ($\chi^2$ = 7.025; $p$ = 0.030) (Table 3). The COVID-19 training course was organized by 55.5% of medical faculties (Table 4).

The resource materials that the survey participants reported using to obtain information about COVID-19 were social media (32.8%), the Republic of Turkey Ministry of Health official website (30.7%), and the World Health Organization official website (14.5%). Differences in the level of knowledge were found based on the source of information, such as the WHO official website, the Ministry of Health official website, a biomedical literature website (e.g., PubMed), and social media ($p \leq 0.001$, $p \leq 0.001$, $p$ =.008, $p$ = 0.001, and $p$ = 0.002, respectively) (Table 4).

Half of the participants (50.6%) reported reading the Turkish National COVID-19 Infection Guidelines released on 2 April 2020 (Table 4). There was a significant statistical difference between this item and the participants' level of knowledge (U = 71,121, $p \leq 0.001$) (Table 3).

## 4. Discussion

The COVID-19 pandemic has affected the lives of healthcare professionals both physically and psychologically. Of the study participants, we found that 64.7% were concerned about becoming infected with COVID-19. Moreover, we found a significant difference in the distribution of the students' knowledge levels about the disease (U = 49,647, $p$ = 0.001). Reportedly, when an individual is apprehensive about having limited knowledge about a topic [13], fear is the first obstacle on the path to gaining knowledge. Typically, as the level of knowledge increases, fear and anxiety decrease. Our study results showed that as the participants' level of knowledge increased, their fear of becoming infected with COVID-19 decreased. Furthermore, as their level of knowledge increases, participants may believe that they can protect themselves from the disease through the measures they take. However, this belief may also give them a false sense of confidence and cause them to make mistakes. Moreover, we found that one-third of the participants said they believed that the outbreak could not be controlled and were concerned that their medical school education had failed to prepare them to adequately respond to the pandemic. This indicated that the participants' perceptions of their competency were low and further pointed to the lack of decision-making mechanisms. Also, the participants' level of knowledge was closely related to their state of anxiety. This suggests that education, enlightenment, and evidence-based learning are vital.

The findings related to the participants' subjective self-assessments about COVID-19 showed that the level of knowledge was different in each group ($\chi^2$ = 89.562; $p \leq 0.001$),

**Table 4.** The distribution of final medical students' preferences and status of education on COVID-19 ($n$ = 860).

| | | n (%) |
|---|---|---|
| Have you received any training on COVID-19 in your medical faculty before the start of pandemic in Turkey? | No | 769 (89,4) |
| | I have no idea | 21 (2,4) |
| | Yes | 70 (8,1) |
| Have you received any training on COVID-19 in your medical faculty after the start of pandemic in Turkey? | No | 812 (94,4) |
| | Yes | 48 (5,6) |
| If yes, in what way did you receive the COVID-19 training? | Face-to-face | 28 (3,3) |
| | Distance education | 35 (4,1) |
| Which organization was the training course provider? | Own Faculty's course | 40 (4,7) |
| | WHO course | 16 (1,9) |
| | Private Institution's course | 10 (1,2) |
| | Medical Association's course | 8 (0,9) |
| | International Faculty's course | 3 (0,3) |
| How much do you think you know about COVID-19 disease? | Nothing | 35 (4,1) |
| | High | 181 (21) |
| | Low | 644 (74,9) |
| Do you follow the updates regularly about COVID-19 disease? | No | 133 (15,5) |
| | Yes | 727 (84,5) |
| Where do you follow the updates on COVID-19 disease?* | Social Media | 642 (32,8) |
| | Ministry of Health official website | 601 (30,7) |
| | WHO official website | 284 (14,5) |
| | Chamber of Medical Doctors official website | 162 (8,3) |
| | Biomedical literature website such as Pubmed | 138 (7,1) |
| | Medical Associations' official websites such as Association Of Public Health Specialist (HASUDER) | 19 (1) |
| | Other | 110 (5,6) |
| Have you read the COVID-19 (SARS-CoV-2) Infection Guide of the Scientific Board released on 2 April 2020? | I reviewed quickly | 268 (31,2) |
| | No | 291 (33,8) |
| | I know, but I did not read | 134 (15,6) |
| | Yes | 167 (19,4) |

*Multiple answers are given.

suggesting that final year medical students have a high perception of self-efficacy.

It is widely accepted that effective self-assessment is a critical skill for any healthcare professional. It is one of the basic skills implicit in our current models of self-directed learning, continuing education, and self-regulation. Kevin W. Eva and Glenn Regehr emphasize the importance of these three points: (1) there is little or no correlation between a group of individuals' self-assessments and externally generated assessments of those individuals, (2) all but the highest performers tend to overestimate their performance and ability, and (3) the worst offenders are in the lowest quartile of performance, with most of these individuals believing that they are above average in performance. Such findings place the notion of self-directed learning and self-regulation in jeopardy [14].

It is pleasing that the study participants have a high level of perception in the context of educational management. On the other hand, it is necessary to approach this finding and its possible consequences carefully, as Eva and Regehr emphasize. It is essential to determine whether this is an educational success or the Dunning–Kruger effect, a label given to observations of meta-ignorance and its consequences in many domains concerning the assessment of both abstract (e.g., cognitive ability) and specific (e.g., knowledge about a certain subject) skills. One well-documented trait is the observation that people who lack certain skills tend to not only judge their skills poorly but also struggle to accurately assess the skills of others. For example, Dunning and Kruger found that people who perform poorly on abstract grammar tests overestimate their abilities and underestimate the abilities of those who performed comparatively better [15]. Under the Dunning–Kruger effect, our students may take unnecessary risks, have insufficient protection, or may cause malpractice: therefore, the instructors must be aware of those possibilities.

In this study, we found that the final year medical students who participated voluntarily had a moderate level of knowledge about COVID-19. This was similar to results reported by Yap et al. [16], who found that 69% of healthcare workers were knowledgeable about the influenza pandemic. However, in our study, the number of participants with a high level of knowledge about COVID-19 was lower compared to the number reported by Taghrir et al.'s study [12]. Taghrir et al. found that 79.6% of the medical students surveyed had a high level of knowledge about COVID-19, which was higher than previous studies conducted on healthcare workers [12]. In our study, a low level of knowledge was apparent in responses to the questions regarding swab sampling (25.5%), asymptomatic COVID-19 cases (5.2%), the use of disinfectants (7.3%), reporting the COVID-19 as a notifiable infectious disease (10.8%), and the proximal origin of SARS-CoV (22%). However, the lack of similar questions on these low-response issues in previous studies may explain the difference in the level of knowledge found in this study.

The question that was most often answered incorrectly (87.5%) was the true/false question 'The virus can be detected in the respiratory secretions of asymptomatic people and the infection is transmitted mainly from asymptomatic individuals.' Asymptomatic cases are diagnosed based on positive viral nucleic acid test results in people without any COVID-19 symptoms. In the study conducted by the Novel Coronavirus Pneumonia Emergency Response Epidemiology Team of

China, only 1.2% of 72,314 COVID-19 cases were found to be asymptomatic [17]. However, Nishura et al. indicated that perhaps 41.6% of COVID-19-infected individuals are asymptomatic [18]. Although more studies are required to determine the exact frequency of asymptomatic cases, the data show that these people may develop mild COVID-19 symptoms, and the probability of them transmitting the disease is low [18]. Thus, asymptomatic cases are not the primary group responsible for the transmission of the COVID-19. The absence of questions about asymptomatic cases in other studies may explain the difference in the level of knowledge results between those studies and our study.

It has been recommended that floors and walls should be cleaned using quaternary ammonium compounds, that stethoscopes and defibrillators should be cleaned using 70% ethanol, that surfaces that have been contaminated with blood and body fluids should be cleaned using household bleach (0.5%), and that other equipment should be cleaned using hydrogen peroxide (0.5%); however, there is no need to use additional bleach when laundering dirty clothes [4]. In our study, only 7.3% of study participants correctly answered the survey item 'Household bleach (at 1:100 normal dilution) should be used for white laundry.' This specific question about the use of disinfectants differentiates the present study from other studies in the literature on SARS, MERS, and COVID-19 [12,16,19].

In 2020, COVID-19 was included in the list of notifiable infectious diseases [4,20]. When a possible case is identified, the Provincial Health Directorate Infectious Diseases Unit should be informed first [4]. Nevertheless, only 10.8% of the participants in our study answered this question correctly. While answers to other questions can be found through the media, this information can be only obtained through education and experience. Therefore, it was not surprising that the study participants could not answer this question. However, this information is essential for medical students after they graduate, so it must be acquired through their education.

The proximal origin for SARS-CoV-2 remains unclear, but the zoonotic transfer is suspected [21]. In response to the question 'SARS-CoV is transmitted to humans from civet cats,' which is about the origin of SARS, 22% of the participants answered correctly. In the literature, although questions were asked about the transmission from animals to humans, no specific animal species was identified [21]. This specific question reduced the rate of correct responses among the participants.

Social media has become an increasingly powerful tool used by physicians to disseminate knowledge to one another, their learners, patients, and the public. Many uses of social media have emerged, with journals, scientists, and researchers increasingly using it to reach their end users and engage in education and knowledge translation. Knowledge translation is defined as the communication between scientists, healthcare professionals, educators, and journals to convey information. Learners are more likely to prefer social media than traditional medical education and resident translation of learning [22].

Social media could act as a major conduit for sharing pandemic-related information and experiences in real time. As COVID-19 evolved and spread across continents, international and national stakeholder organizations (e.g., WHO, CDC), news outlets, and individuals began using social media to share information broadly. A major benefit of social media for information sharing is the instantaneous access to the most recent literature available. As journals have prioritized rapid review and open-access publication of COVID-19-specific studies, keeping up with the latest literature has become even more overwhelming than before [23].

The WHO defined the present situation of excessive correct and incorrect information about the COVID-19 pandemic posted on social media as an infodemic [24]. This has made it difficult for people to access reliable and valuable information although social media (32.8%) is the source people most often use to obtain information. Social media platforms provide direct access to an unprecedented amount of content, but they may amplify rumors and present questionable information based on users' preferences and attitudes interpreted by algorithms to mediate and facilitate content promotion [25]. Thus, in these times in which the accuracy of information is threatened, a COVID-19 training course is crucial for final year medical students, who are also high social media users, because approximately 94% of them reported receiving no education about COVID-19 at their medical schools.

The literature is inconsistent about how final year medical students can contribute to healthcare right now. Some medical schools forbid any patient interaction, while others either hire students for hospital-based roles or graduate medical students early to serve in hospital triage units or front offices. The Association of American Medical Colleges (AAMC) has instructed medical schools to suspend student licenses and suggested that unless a locally critical healthcare workforce is needed, medical students should not be included in any patient care. Some studies have identified areas where medical students can work, including routine outpatient clinical care, calling patients to provide them with laboratory test results, providing patient education, and using telemedicine technology to follow up or check in with patients who have been discharged [26].

Feedback from the study participants indicates that an educational and experiential opportunity must be provided to them, and their perceptions of competency must be facilitated and motivated. Therefore, a COVID-19 training course should include these topics: diagnosis and treatment of COVID-19, outbreak management, and filiation; interviewing an individual who has had contact with a COVID-19 case; clinical skills (e.g., using personal protective equipment, CPR, swab sampling, oxygenation, intubation); community health education; protecting mental health and overcoming uncertainties; and the ability to analyze, evaluate, and comment on pandemic management. In addition, final year medical students with a low level of knowledge were recommended to complete the certified COVID-19 training organized by the medical education associations in Turkey.

This study of the COVID-19 pandemic is a good example for demonstrating the need for additional education and training in public health preparedness in medical schools. Besides improving the knowledge, attitude and practices (KAP) around COVID-19 among final year medical students, the participants' feedback about current pandemic education can help curriculum developers to further align training with students' expressed needs in

the management of a global health disorder. International health educators can use the participants' answers and the survey questions about information and perceptions to determine the requirements, competence, and content definitions of a curriculum related to COVID-19 and to enable comparative studies. As in Turkey, this study can help in creating a standard structure in the fight against COVID-19 and increase the level of knowledge of medical students worldwide.

This study was conducted one month after the first COVID-19 case was seen in Turkey. The difference between this study and other similar studies is that this is a national study involving six medical schools; thus, the number of participants was high [3,12]. The participants' level of knowledge was studied in detail, including about diagnosis, sampling, mandatory reporting of the disease, and necessary personal protective measures around COVID-19. Another powerful aspect of this study was the integrated evaluation of the participants' perception and knowledge levels toward COVID-19 immediately after the first known case was detected in Turkey and one month after that.

Our study has some limitations. First, the data and relevant analyses we presented in this paper were derived from a cross-sectional study design. Thus, it is difficult to make causal inferences based on the findings. Second, to avoid bias we used a web-based survey method, necessitating the inclusion of volunteer participants; therefore, the possibility of selection bias should be considered. Another limited area of concern is the less weightage given to diseases such as SARS, HIV, etc., in medical education curricula before the COVID-19 pandemic. These diseases are among disorders that create a stigma similar to that around COVID-19 and also require preventative measures. Handling these diseases and providing students with competency will benefit future outbreaks. Because our study was conducted using only six medical schools in six regions in Turkey, the applicability of the results to in other medical schools is limited. Also, local knowledge and culture in these schools and regions differ from those in other regions and countries. Additionally, information about COVID-19 is continuously expanding and changing, thus the survey questions about virus knowledge will need to be evaluated and revised for future studies. Another limitation of our study is that there may be leaks in the data collected through Google Forms. For example, partial responses cannot be stored in such forms, meaning that some students may not have completed the survey after answering a question because they became bored, were stuck in information questions, etc.

## 5. Conclusion

Our study analyzed data concerning final year medical students' levels of knowledge and perceptions of COVID-19 in Turkish medical schools. Consequently, we determined that final year medical students were knowledgeable about and aware of the pandemic. Thus, medical educators should inculcate relevant knowledge and educate medical students so that healthcare practices can be improved during this pandemic and in future epidemics. Different learning techniques, such as online problem-based, computer-generated simulations, case analysis, and task training, should be added to medical school curricula, especially at a time when widespread fear and uncertainty are prevalent.

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## Declaration of interest

The contents of the paper and the opinions expressed within are those of the authors, and it was the decision of the authors to submit the manuscript for publication.

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## ORCID

Fatih Çalışkan http://orcid.org/0000-0001-7786-3929
Özlem Mıdık http://orcid.org/0000-0002-0151-7461
Zeynep Baykan http://orcid.org/0000-0001-9450-985X
Yeşim Şenol http://orcid.org/0000-0002-7842-3041
Esra Çınar Tanrıverdi http://orcid.org/0000-0001-8857-3986
Funda İfakat Tengiz http://orcid.org/0000-0002-8491-9190
Albena Gayef http://orcid.org/0000-0002-1260-0631

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