Impact of COVID-19 pandemic on medical education in Greece: A cross-sectional study

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Abstract

Background: Medical education was widely affected by the Coronavirus disease 2019 (COVID-19) pandemic. Long-distance learning was implemented over the traditional educational paradigm. Clinical clerkships were canceled, and evaluation methods were altered. This study aims to assess this multifaceted impact on the Greek undergraduate medical community.

Methods: A cross-sectional survey study was conducted. All undergraduate medical students at Greek Universities were addressed using social media. The data were post-stratified according to the population's male-to-female ratio and underwent descriptive and inferential statistical analysis. Associations were determined using chi-square and Fisher's exact test. A linear regression model was developed to investigate the factors that contributed to the overall impact of the pandemic on medical education.

Results: A total of 905 responses were analyzed, representing 9.8 % of Greece's medical students. Most reported decreased duration of laboratory (n =711, 78.5 %) and clinical (n =526, 96.7 %) practice. The majority stated that their ability to perform practical skills was affected negatively (n =805, 89.0 %). The impact on student's education was positively associated with their psychological impact. Therefore, a more negative effect on the student's education was observed on those whose psychology was affected more negatively [β =0.49, 95 % confidence interval (CI): 0.40, 0.58, p <0.001). Additionally, the pandemic's overall impact on medical education was much more unfavorable for the clinical than the pre-clinical students (β =-0.30, 95 % CI: -0.40, -0.20, p <0.001).

Conclusions: This study's findings agree that the COVID-19 pandemic has severely impacted the education and personal life of medical students, especially in the advanced years. An insight into their specific needs to overcome the impact on their education is provided. The necessity of future mitigating actions is underlined. Emphasis should be given to clinical skills and enhancing the students' adaptive behavior to attenuate the consequences on their psychology, social life, and future healthcare provider careers. HIPPOKRATIA 2022, 26 (2):55-61.

Keywords: COVID-19 pandemic, distance learning, Greek medical schools, medical education

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Introduction

The first coronavirus disease 2019 (COVID-19) cases were reported in late December 2019 in Wuhan, Hubei Province, China, as pneumonia of unknown etiology[1]. In January 2020, the causative agent was successfully identified and later classified as a strain of the severe acute respiratory syndrome-related coronaviruses (SARS-CoVs) named SARS-CoV-2[2]. Following a rapid global outbreak that took massive proportions, COVID-19 was declared a global pandemic on the 11th of March 2020[3].

Greece reported its first confirmed COVID-19 case on the 26th of February 2020 in Thessaloniki. The Greek government reacted quickly and drastically by canceling all major social events, including all educational procedures requiring physical presence for all levels of education, on the 10th of March 2020[4]. Shortly after, on the 22nd of March 2020, general lockdown measures were enforced[5,6].

Regarding medical education, all clinical clerkships, laboratory exercises, and in-person lectures were canceled on the 10th of March 2020, and directions for distance education were given[4]. These measures were lifted from the 21st of May 2020 until the end of the academic year 2019-2020 (31st July 2020)[7]. During the next academic year (2020-2021), students were allowed to physically attend classes for a brief period, from the 4th of September until the 6th of November 2020, after which they were postponed[8,9].

The above indicates the necessity for significant changes to the conventional medical education models.

Utilizing modern technological methods to render possible long-distance teaching was a desideratum[10]. Notable examples of these methods include online lectures, social media-based chatrooms, and simulation scenarios to substitute the lost student-patient contact[11,12]. Similar adjustments were made concerning the students' evaluation methods[13]. Therefore, the circumstances created by the COVID-19 pandemic have urged medical schools to adopt new and perfect their existing virtual learning capabilities. This action was taken to minimize the long-lasting effects on medical education and as a means of vigilance against analogous public health crises[13,14].

We hypothesized that this crisis, combined with the profound changes in the educational paradigm during the lockdown, may have had an unfavorable effect on medical students' activities, interactions, and perceptions during their undergraduate studies. Undoubtedly, the short- and long-term impact of the COVID-19 pandemic on medical students will have to be extensively evaluated[10,12]. The primary aim of this study was to assess the aspects and severity of this multifaceted impact across the Greek undergraduate medical community and contribute to the improvement and recovery of medical education after that period.

Methods
Study design, participants, and procedure

This nationwide, cross-sectional survey study has included undergraduate medical students in Greek universities. The objectives and methods were predefined in a protocol registered on the Open Science Framework (OSF) (Center for Open Science, Charlottesville, VA, USA) website[15]. The institutions were directly contacted to provide information on the number of their registered students to produce the response rate of our study. Students who disagreed with their data being processed for the purposes of the study were excluded.

A 45-question survey questionnaire was drafted using Google Forms (Google LLC, Mountain View, CA, USA). The questions were conceived after thoroughly investigating the available literature concerning the global effects of COVID-19 on medical education and social interactions. As this was a preliminary study trying to assess these effects, it did not involve instrument development or qualitative analysis beforehand. The final questions included in the online form are listed in detail in our study protocol[15]. The self-administered questionnaire was distributed using the students' groups on the social media platform Facebook (Meta Platforms, Menlo Park, CA, USA). It was available for completion between November 5 and December 3, 2020, after which the link to the online questionnaire was deactivated. During the above period, the link was shared three times to maximize the number of participants and produce a representative sample size. To proceed to the questionnaire, students had to declare their consent to participate in the survey. The study has received ethics approval from the Committee for Bioethics and Ethics of the School of Medicine of the Aristotle University of Thessaloniki (Protocol No 3301, date: 20/12/2020).

The questionnaire requested information about students' demographics and the impact the COVID-19 pandemic had on numerous aspects of their medical education and social life. It contained questions regarding their experience with distance learning, lockdowns, and the impact of these events on their education. Mainly, questions required a scaled response and were answered based on a Likert scale, ranging from 1 to 5, with a direction of the scale from negative to positive. Other question types were limited and included polar questions (yes or no, with an additional "I do not know" option) and questions regarding demographic characteristics that provided the appropriate choices (gender: male, female, other/I would rather not answer; medical school location, stage of training: clinical, pre-clinical). Answering all the questions was mandatory for the submission of the online form. Hence, all the received questionnaires had been fully completed and could be included in the statistical analysis. No identifying information was obtained. Anonymized participant data will be made available upon requests directed to the corresponding author.

Statistical analysis

All data were collected through the participants' answers in the specially designed online Google Form. After extraction, analyses were processed using the statistical package IBM SPSS Statistics for Windows, Version 25.0 (IBM Corp., Armonk, NY, USA). Post-stratification according to gender was applied to weigh the difference between the sample's and the population's male-to-female ratio. All data presented in this article are post-stratified, processed data.

We summarized categorical variables with frequencies and percentages and utilized chi-square or Fisher's exact tests (whenever the expected count was less than five) to determine the association of categorical variables.

The association of the overall impact of the pandemic on medical education with other factors was investigated with linear regression. The higher the score, the more positive the overall impact on medical education was. In the multivariable model, the stage of studies (pre-clinical and clinical) was considered as the main independent variable, adjusting for the participant's medical school, gender, pandemic's impact on the future choice of career/specialty, and pandemic's impact on psychology. The beta-coefficients were presented with the corresponding 95 % confidence intervals (CI). All p-values were two-tailed at a 5 % significance level.

Results
Demographic characteristics

Nine hundred eleven completed questionnaires were collected from medical students of all seven Greek Universities' medical schools, representing 9.9 % of the undergraduate medical students' population (n =9,241), based on records received from the affiliated institutions.

Regarding gender, 595 participants (65.3 %) were female, 310 (34.0 %) were male, and six (0.7 %) did not disclose it. The difference between the male-to-female ratio of the sample (male: 34 %, female: 65.3 %) and each university's actual ratio (combined: male: 43.8 %, female: 56.2 %) necessitated the application of post-stratification weights. Due to their negligible proportion and the need for gender weighting, the students who did not disclose their gender (n =6, 0.7 %) were excluded from all further statistical analyses, thus lowering the sample size to n =905 and the response rate to 9.8 %.

Three hundred fifty-eight (39.6 %) of the responders were in the pre-clinical years of their studies, and the rest, 547 (60.4 %) in their clinical years. A detailed report of the sampling procedure is shown in Figure 1, and further sample characteristics are available in Table 1.
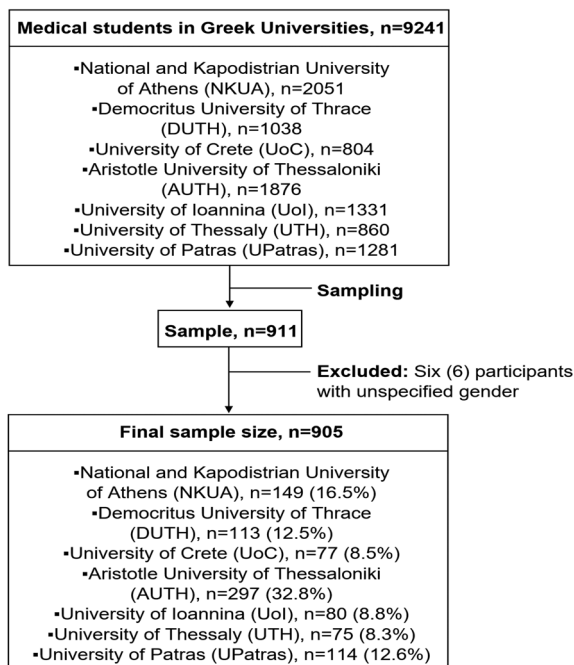

Figure 1: The sampling procedure of this cross-sectional survey addressed to undergraduate medical students at Greek Universities.

Impact on the educational process
i. Impact on theoretical learning

The majority of the participants reported that the total duration of the theoretical lectures was not affected (n =533, 58.9 %). Their quality, though, was considered decreased by most (n =536, 59.3 %). The majority perceived teacher-student interaction as decreased (n =717, 79.2 %). Students' participation in lectures was also reported decreased for almost half of them (n =425, 46.9 %) but was unaffected for almost a third (n =274, 30.3 %). Interestingly, decreased participation was reported by a substantial proportion of pre-clinical students compared to students in the clinical stage (57.3 % vs. 40.1 %, p <0.001). Moreover, the pandemic's negative impact on students' theoretical training was remarkably higher for those with decreased participation in lectures than those with increased participation (53.3 % vs. 16.0 %, p <0.001). The impact on their theoretical education was not significantly associated with their stage of training (p =0.38). Clinical students more frequently reported a vague feeling of sufficient preparedness for the next semester compared to those in the pre-clinical stage (82.3 % vs. 66.6 %, p <0.001).

ii) Impact on practical learning

Notably, insufficient laboratory training was observed as well. Most students reported that the laboratory practice was of decreased duration (n =711, 78.5 %) and quality (n =704, 77.8 %). The majority (n =544, 60.1 %) admitted that increasing theoretical education did not substitute it. Nearly all clinical students mentioned lessened duration (n=526, 96.7%) and quality (n =476, 87.3 %) of clinical practice. Naturally, the student's ability to perform practical skills was considerably affected for clinical rather than pre-clinical students (93.5 % vs. 81.7 %, p <0.001).

iii) Impact on studying and evaluations

The duration and quality of total study time, as well as the student's individual interest in studying, varied

Table 1: Basic characteristics of the study sample based on the students' institution.

	Male		Female		
	pre-clinical years	clinical years	pre-clinical years	clinical years	Total
National and Kapodistrian University of Athens	25	34	35	55	149 (16.5 %)
Democritus University of Thrace	14	26	22	51	113 (12.5 %)
University of Crete	17	12	30	18	77 (8.5 %)
Aristotle University of Thessaloniki	40	58	76	123	297 (32.8 %)
University of Ioannina	9	18	17	36	80 (8.8 %)
University of Thessaly	14	14	13	34	75 (8.3 %)
University of Patras	11	18	35	50	114 (12.6 %)
Total	130 (14.4 %)	180 (19.9 %)	228 (25.2 %)	367 (40.6 %)	905

Values are presented as number and percentage in brackets.

among participants. About half of the responders' examinations were postponed (n =440, 48.6 %). Most of the exams were held online (n =648, 71.6 %), and for a fair proportion of students, the evaluation methods differed from those used before the pandemic (n =572, 63.3 %). Most students believed that these changes would not affect them positively (n =653, 72.1 %), with a higher proportion of pre-clinical students feeling that they were affected negatively compared to clinical students (79.4 % vs. 67.3 %, p <0.001). Despite that, a significant number of students revealed that their actual performance in their examinations was not affected (n =426, 47.0 %). Overall, the pandemic has had a much more unfavorable impact on the pre-clinical students' performance on examinations than the clinical students (32.2 % vs. 18.1 %, p <0.001).

iv) Impact on extracurricular and social activities and mental health

Academic progress was one of many aspects that had been affected. Responders agreed that their extracurricular activities related to academic topics were significantly lessened (n =690, 76.3 %), while the impact on their interest was mainly negative (n =492, 54.4 %). A decreased engagement with arts was also reported (n =625, 69.0 %). The students also confessed to decreased quality of their interpersonal relationships with friends (n =680, 75.2 %). An almost equal share (n =665, 73.5 %) experienced a negative impact on their social relationships in general.

The vast majority (n =668, 73.8 %) of the students reported experiencing a negative psychological effect in multiple aspects. In detail, a considerable proportion of students with a negative impact on their mental health had decreased performance in their examinations (82.6 % vs. 2.3 %, p =0.001) and a feeling of insufficient preparedness for the next semester (78.8 % vs. 2.3 %, p <0.001), compared to positively affected students.

Overall assessment of the pandemic's impact

A detailed report of the response data regarding the impact of the pandemic on various aspects of the participants' lives and education is available in Table 2.

The students' career choices were largely unaffected by the pandemic (n =458, 50.6 %). Of those whose choice was impacted, most belonged to the clinical years of training (20.2 % vs. 7.5 %, p <0.001). Diverse perceptions towards how their Medical School handled the crisis were given.

The students agreed that the overall impact of the COVID-19 pandemic on their medical education was, at the minimum, negative (n =748, 82.7 %). There was no association between gender and the pandemic's overall impact (p =0.08).

The linear regression model (Table 3) revealed that the impact on medical education was significantly worse in the clinical stage compared to the pre-clinical stage (β =-0.30, 95 % CI: -0.40, -0.20, p <0.001). It also indicated that the better the student's psychological state, the more

Table 2: Assessment of the overall impact of the COVID-19 pandemic on various aspects of the students' education and personality.

	Very little	Little	Not at all	Much	Very much
Impact on future choice of career	113	197	458	103	34
	(12.5 %)	(21.8 %)	(50.6 %)	(11.3 %)	(3.8 %)
	Very badly	Badly	Neutrally	Well	Very well
Assessment of the way their Medical School handled the health crisis	101	236	292	214	62
	(11.2%)	(26.1%)	(32.2%)	(23.6%)	(6.9%)
	Very negatively	Negatively	Not affected	Positively	Very positively
Social activities	366	437	84	13	5
	(40.4 %)	(48.3 %)	(9.2 %)	(1.5 %)	(0.6 %)
Social relationships	274	391	201	30	9
	(30.3 %)	(43.2 %)	(22.2 %)	(3.4 %)	(1.0 %)
Interest for extracurricular activities	205	287	230	158	25
	(22.6 %)	(31.8 %)	(25.4 %)	(17.5 %)	(2.7 %)
Psychology	280	388	204	29	4
	(30.9 %)	(42.9 %)	(22.6 %)	(3.2 %)	(0.4 %)
Theoretical training	42	292	417	134	21
	(4.6 %)	(32.2 %)	(46.1 %)	(14.8 %)	(2.3 %)
Ability to perform practical skills	444	361	89	8	3
	(49.1 %)	(39.9 %)	(9.9 %)	(0.9 %)	(0.3 %)
Interest for their education	69	280	398	131	26
	(7.7 %)	(31.0 %)	(44.0 %)	(14.5 %)	(2.9 %)
Feeling of sufficient preparedness for the next semester/ rotation/ lesson, etc	301	388	162	46	8
	(33.2 %)	(42.8 %)	(18.0 %)	(5.1 %)	(0.9 %)
Overall impact on their education	220	528	110	37	10
	(24.3 %)	(58.4 %)	(12.1 %)	(4.1 %)	(1.1 %)

Values are presented as number and percentage in brackets.

Table 3: Linear regression model of the factors contributing to the overall impact of the pandemic on medical education.

Variables' relationship examined:	Univariable Analysis			Multivariable Analysis (Adjusted for Participant's "Medical School" and "Gender")		
	Unadjusted β	95 % CI	p-value	Adjusted β	95 % CI	p-value
"Overall impact of the pandemic on medical education" with:						
Pre-Clinical/ Clinical stage	-0.31	(-0.41, -0.20)	<0.001	-0.30	(-0.40, -0.20)	<0.001
Pandemic's impact on future choice of career/ specialty	-0.12	(-0.19, -0.05)	0.001	-0.05	(-0.12, -0.18)	0.14
Pandemic's impact on psychology	0.49	(0.40, 0.58)	<0.001	0.49	(0.40, 0.58)	<0.001

CI: Confidence interval.

positive the overall impact on their medical education (β =0.49, 95 % CI: 0.40, 0.58, p <0.001). The more significant the impact of the pandemic on the future choice of career/specialty, the more negative the overall impact was on medical education in the univariable analysis (β =-0.12, 95 % CI: -0.19, -0.05, p =0.001), but not in the multivariable model (p =0.14).

A data supplement providing additional report tables of the statistical analyses is available on OSF.

Discussion

This cross-sectional study has assessed the impact of the COVID-19 pandemic on medical students across Greece. It concluded that this impact was considerably negative and concerned both their education and social life. Furthermore, the attributes of these effects were revealed, and they were in accordance with the findings of numerous similar international studies.

A national survey conducted in the United States has shown that many students feared the pandemic would affect their future careers, with concerns about their competitiveness as residents. Concerning their extracurricular activities, more than 50 % chose to engage in their well-being and hobbies[16]. This has come in contrast to our findings, as students in Greece had a decreased engagement with extra-academic activities.

As stated above, Greek authorities have made distance learning mandatory for all levels of education. Similar restrictions were implemented in various other countries[17]. Our study has shown a negative effect on the student's medical education, arguing with an older study that has found that medical students especially view e-learning as a functional and pleasant asset[18]. The disagreement lies in the fact that one can benefit from distance learning solely if it takes place additionally to their direct practice and not if it completely replaces it[19]. Wang et al state that most students in China described their e-learning experience as ineffective, with advanced-year students evaluating the impact of the pandemic more strictly[20]. The latter agrees with our findings, as clinical students were affected to a greater extent.

Medical students in Libya also experienced remarkable effects on their academic and personal life, according to Alsoufi et al[21]. They reported effects on their school's timeline along with a decreased ability to comprehend new materials. Most participants had a similar perception to those in Greece regarding their choice of specialty since only 26.8 % reported that it had been altered because of the pandemic. However, contrary to our findings, more students believed sufficient interactions were achieved during online teaching in Libya. Nonetheless, only 21.1% concluded that online lessons accounted for clinically based lessons[21].

Concerning the effects on personal life, a study by Loda et al held in Germany disagrees, as it revealed that only a small proportion of students were affected. Nevertheless, more than half of the students felt more anxious about their education and future careers[22]. Similarly, final-year medical students in Pakistan reported feelings of burnout, loneliness, and depression. In accordance with our findings, this was partly due to the unsatisfactory response of their schools to begin online classes on time and their inadequate preparation concerning exams and practical skills[23].

It is manifest that the foundations of medical education have changed throughout the COVID-19 pandemic. Adapting to these changes will benefit both medical students and their future patients. Cinoku et al have elucidated that the *sine qua non* for improving the Greek healthcare system is the improvement of medical education[24]. Thus, the already limited practical experience gained by medical students during their undergraduate studies was severely diminished during the pandemic. It is essential to replenish this lost exposure to real conditions.

At the global level, it is suggested that every change in medical education should follow some guiding principles and an evaluation protocol to assess its effectiveness[25]. Such methodology was followed by some of New York's Medical Schools in early 2020, during the outbreak of the COVID-19 pandemic. The lessons learned were crucial for preserving education at a sufficient level, highlighting the importance of a predefined strategy[26].

This study is subject to some limitations. Firstly, the questionnaire was distributed using the social media platform Facebook, so students without internet access or a Facebook account had no direct access to the survey.

It should, however, be noted that every Greek Medical School has a student-created Facebook group/community, which was addressed. Moreover, it was a single-country study, and the results cannot be generalized to other countries. It could, though, be used for comparison in further research. Another limitation is that the study was conducted during the quarantine period, and the possible following events could have altered the conclusions, resulting in different responses. We also used Likert-scaled questions to assess the impact of COVID-19 on medical students' perceptions since there were no available validated scales regarding the impact of COVID-19 on education. Potential bias in the survey may have also affected the results given by the students, as students more interested in or affected by matters of medical education were more motivated to participate in the survey.

According to this study's findings, future studies are suggested to evaluate the consequences of the pandemic on medical education to contribute to the targeted planning of the necessary mitigating actions. These should be prioritized, emphasizing severely influenced aspects like clinical skills. Ultimately, the challenge is learning from experience and encouraging effective, meaningful changes to improve medical education and healthcare systems globally.

Conclusion

The COVID-19 pandemic significantly impacted medical students in all stages of their education. The most significant influence was observed in the clinical stage of medical education. The canceled clinical clerkships and the absence of direct contact with professors and patients resulted in losing confidence and interest in their education. The student's ability to perform practical procedures was also significantly affected. Notably, the student's psychological state during the lockdown period was essential in determining their perceptions of their education. Further evaluation is necessitated to alleviate these effects on medical education.

Conflict of interest

Acknowledgments

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